

SCIENCE ABSTRACTS.

Section A.—PHYSICS.

MARCH 1905.

GENERAL PHYSICS.

499. *Metallic Manometers Tested by Means of the Amagat Manometer.* E. Wagner. (Ann. d. Physik, 15. 5. pp. 906-953, Dec. 23, 1904. Extract of Munich Dissertation.)—The accuracy of the Amagat manometer is first investigated, special attention being paid to the measurement of the plungers and cylinders and the determination of their effective cross-section. Two Bourdon pressure gauges, one made by Bourdon, of Paris, the other by Schäffer and Budenberg, of Magdeburg, were then compared with the Amagat apparatus under various conditions designed to test the constancy of their indications, particularly as affected by temperature changes and past history in the form of elastic after-working. For experimental details the reader is referred to the original paper. The general conclusions of the author are: (1) The experimental determination of the effective areas of the plungers in an Amagat manometer renders its absolute indications certainly correct to ± 0.5 per thousand, with a sensitiveness of ± 0.025 atmos. The experiments were carried up to 300 atmos. pressure. (2) The Magdeburg pressure gauge tested by comparison with the above Amagat apparatus was found capable of giving readings constant to within ± 0.08 atmos. under constant conditions of employment. The temperature coefficient was determined, and for various typical modes of using the manometer the effects of elastic after-working could also be accurately corrected from the experimental data obtained, and the author considers that an additional error from these causes of ± 0.08 atmos. is probably an overestimate, so that ± 0.11 atmos. is the limit of accuracy obtainable with this instrument. Neglecting corrections for elastic after-working, errors under ordinary conditions will not exceed ± 0.2 atmos.; only under extreme conditions, specially designed to that end, can the maximum error of ± 0.5 atmos. due to after-working be obtained. (3) The instrument by Bourdon (Paris) showed qualitatively similar results, but its errors are everywhere much larger—they may amount to 0.5 per cent. of its readings, and it is in every way less suitable for accurate measurements. (4) As regards the explanation of the various phenomena observed in cycles of elastic deformation, it has been found that the known laws of elastic after-working can everywhere be recognised as the essential factors, and true hysteresis is regarded as an unnecessary and improbable attribute in connection with elastic phenomena.

500. *Manufacture of Thermometer Glass at Jena.* E. Grieshammer. (Zeitschr. Instrumentenk., Beib. 23. pp. 233-235, Dec. 1, 1904. Report read before the 13 Hauptversammlung des Ilmenau Zweigvereins der Deutsch. Gesell. f. Mechanik u. Optik, Aug. 6, 1904, at Jena.)—In order to controvert the view recently expressed that the Jena glasses 16^m and 59^m have recently become softer than formerly [see Abstract No. 546 (1905)], the present author gives an account of the methods by which the Jena glass-works (Schott and Co.) maintain the regularity of composition of the glasses. The chemical composition of these two glasses has long been known, and no change has been made in them since 1886. The raw materials used are quartz sand from Hohenbocka, soda ash made by the Solvay process, and free from potassium, zinc oxide containing not less than 99 per cent. ZnO, lime spar from the Fichtel Gebirge, boric acid, almost chemically pure, in flocculent crystals, and alumina as a pure dried hydrate, free from alkalies. Mixing is done by hand, in bins reserved for these glasses, and in batches only large enough to fill a single melting-pot. The furnace used contains one pot only, and there is no mixture nor broken glass of other kinds in the vicinity. The only possible variation from one melting to another is in the length of time during which the glass remains fluid in the furnace. If this time is prolonged the glass takes up rather more material from the containing vessel. It is, however, considered that this does not influence the composition of the glass by more than 0.5 per cent. of alumina, and such small variations are regarded as unavoidable in technical manufacture. At all events this is not a cause which has operated in a greater degree recently than formerly. The author considers that the precautions to secure constancy of composition are so complete that he feels entitled to doubt the truth of the view that the glasses have latterly become softer. He mentions, finally, that these glasses are melted without the addition of arsenic. A small addition of arsenic was tried with a view to aiding the "fining" of the glass, but it was found that the presence of even 0.1 to 0.2 per cent. of As_2O_3 caused a distinctly visible discolouration of the glass when worked in the blowpipe, and its use was abandoned. For this reason the glass cannot be obtained as free from bubbles as some other glasses. W. Ros.

501. *Influence of Method of Procedure in Deformation on Elastic Properties of Marble.* P. Gamba. (Accad. Lincei, Atti, 13. pp. 538-541, Dec. 4, 1904.)—In an earlier paper [see Abstract No. 641 (1899)] the author has described experiments on the deformation of a slab of marble supported at the ends and loaded in the middle, and in the present paper he proceeds to examine the effect of applying the load in various ways. Two sets of experiments are described: In the first a load is applied for a given time; then the load is removed, and the residual deformation after an interval of time equal to that for which the load was applied, is observed. The slab is then brought as nearly as possible to its original condition, and another cycle is performed, in which the load is applied in steps of half the original load, applied for half the original time, so that the maximum load and total time are the same as in the first experiment. Further cycles are performed in which the number of steps is doubled, and the loads and times are successively halved, and the results of all the experiments are plotted in one diagram. The points indicating permanent deformations for each load lie nearly on the same curves for all the cycles, and these curves are nearly rectilinear; the unloading curve lies slightly above the loading curve, thus showing that there is a small residual deformation. In the second set of experiments the load is applied

or removed by syphoning mercury into or out of a light wooden box placed upon the marble slab. In this way the load can be applied and removed gradually, but not quite regularly, the result being that the curves have the same general characteristics as before, but are not so regular. The unloading curve cuts the loading curve, the latter being more nearly straight than the former.

502. Diffusion of Air, Oxygen, and Nitrogen through Water and Salt Solutions. E. Ardel. (Beibl. Ann. d. Physik, 28, 17, pp. 905-906, 1904. Extract from Münster Dissertation, 1904.)—The method of Wroblewsky is employed, experiments being made with pure water and with sodium chloride solutions of different concentrations. With pure water the velocity of diffusion does not follow the law of Biot and Fourier, the reason being that currents are produced on account of the upper layers which have dissolved the gas having acquired greater density than the lower layers; thus the rate of diffusion is greater than that indicated by theory. For a mixture of 20 parts by volume of concentrated salt solution and 80 parts of water, the behaviour becomes regular and the diffusion with this and with more concentrated solutions follows the law of Biot and Fourier. In the cases investigated the diffusion coefficient diminishes with increasing concentration of salt and with falling temperature.

503. Formula for Gaseous Diffusion. P. Langevin. (Comptes Rendus, 140, pp. 85-88, Jan. 2, 1905.)—A general expression has been obtained for the coefficient of mutual diffusion of one gas into another, or for the relative mobility under external force, by Maxwell's method, but without the assumption of any particular law of molecular repulsion, a graphic integration analogous to that carried out by Maxwell being employed. If the molecules are elastic spheres, the diffusion-coefficient of a gas with molecules of mass m_1 into a gas with molecules of mass m , of which there are N in unit volume, is, $D = 8/16\pi^2 N \sqrt{\pi h m m_1 / (m + m_1)}$, where σ denotes the sum of the radii of two molecules, one of each kind, and $3/4h$ is the mean kinetic energy of a molecule. The ratio of this value to that deduced by Boltzmann is $(9\pi/32)(m + m_1)\sqrt{(mm_1)}$. The general formula shows that, if the molecular repulsion varies as $r^{-(n+1)}$, the isopiestic diffusion-coefficient varies as $T^{(3n+4)/2n}$. These results help in determining the effect of ions on the neutral molecules of a gas. At ordinary temperature the mobility of the ions in dry air is very small, and we are led to conclude that the diameters of the negative and positive ions are respectively about twice and thrice that of a molecule, owing possibly to electrostatically attracted layers of molecules. In flames it appears that the positive ions have a mass equal to that of an atom of hydrogen, the negative ions being a thousand times less; that the greater part of the conductivity of flames is thus due to the presence of cathodic particles produced by the spontaneous corpuscular decomposition within the flame of some of the molecules owing to the high temperature.

504. Attraction observed between Drops of Liquid Suspended in another Liquid of the same Density. V. Crémieu. (Comptes Rendus, 140, pp. 80-88, Jan. 9, 1905.)—Drops of liquid suspended in a mass of liquid of the same density are removed from the effect of gravity, and their mutual attraction is balanced by the pressure of the supporting liquid; moreover, the capillary effect is negligible when the ratio of distance apart to diameter is consider-

able. Nevertheless, the author has found that such drops approach each other slowly, whatever the ratio of diameter to distance apart. The drops are of olive oil, the supporting liquid being a mixture of alcohol and water, the density of which is adjusted to be the same as that of the drops. The apparatus is situated in a cave, 2 km. distant from the nearest inhabited place, in order that the thermal and other disturbances may be reduced to a minimum. In all the experiments the drops ascended slowly, owing to the gradual alteration in density of the different layers of liquid. By observing the position in plan, of the drops, at intervals of 2 hours, the path described on account of their mutual influence can be traced. In an experiment described two drops approached each other at a speed which is sensibly proportional to the inverse square of their distance apart; also, on introducing a third drop, the first two changed their paths, and the three drops mutually approached each other. Owing to the difficulty of the experiment, only six curves were obtained in two months. S. G. S.

505. *Flow of Water through Pipes.* H. T. Barnes and E. G. Coker. (Roy. Soc., Proc. 74, pp. 341-356, Jan. 23, 1905.)—This continues on a much larger scale the experiments referred to in Abstracts Nos. 1202 (1903) and 1876 (1904). Stream line motion and the critical velocity are studied by the thermal method in which the indication of change from stream line to eddy motion in a hot-jacketed pipe is given by the sudden change of temperature. The apparatus consists essentially of a supply tank, a flow tube with thermometer, a water-jacket, a regulating valve and a calibrated measuring tank. Stream line flow at high velocities, temperature effect on upper limit of critical velocity, temperature variation of lower limit are studied; and comparison with Osborne Reynolds' results is made. J. W. P.

506. *The Structure of an Atom.* H. Nagaoka. (Mathematical and Physical Soc., Tokyo, 2. 17. pp. 240-247, 1904.)—To the author's communication to the Society in 1903 of a dynamical model of an electron atom illustrating the spectral lines and radio-activity, several objections have been raised by Schott [see Abstract No. 962 (1904)]. The present paper deals with these objections. It is explained at the outset that the principal aim was to build up an ideal atom, which would illustrate several physical properties of matter. It was not pretended that the proposed system represents a chemical atom; it was accordingly inexpedient to apply at first constants found from measurements with natural substances. But it is hoped that by investigating the properties of an ideal atom, we may, step by step, aspire to a higher aim, viz., the solution of the structure of natural atoms. In the treatment of frequencies of radial disturbances a mistake in sign noticed by Schott is admitted and the necessary corrections made. The number of electrons in a ring is then discussed, followed in turn by: instability and radio-activity; probable nature of emanation and its evolution; vibration of central charge and its consequences. E. H. B.

507. *Predominance of Counter-Clockwise Eddies in European Watercourses.* J. Brunhes. (Archives des Sciences, 18. pp. 553-576, Dec., 1904.)—Counting only eddies which are marked by surface froth, the author finds that in many Alpine rivers, the Sarne, Neckar, Salzach, &c., and the Rhine rapids near Laufenburg, 90 per cent. of all eddies are counter-clockwise. E. A. Martel has made the same observation, which has been confirmed in the Pyrenees, in

the subterranean rivers of Southern Russia. Just below any bridge pier eddies on the right hand turn counter-clockwise, and those on the left clockwise; their numbers are about equal. Similar small eddies are produced by every stone projecting from shallow water. When the water-level rises, only a few of these eddies can be distinguished, but then the counter-clockwise movement predominates. In the cases of very shallow and very deep waters, and also those of very rapid torrents with steep gradients, the Weisse Lüttschine, e.g., there is no prevalence of either direction. The law of Baer—that rivers tend to deviate to the right—would therefore have to be restricted to the middle reaches of rivers; in the upper and lower reaches other causes mask the small but constant influence of the earth rotation. As to Perrot's experiment, see Abstract No. 20 (1905). H. B.

508. *Deviation during Free Fall.* de Sparre. (Comptes Rendus, 140. pp. 33-35, Jan. 2, 1905.)—The author asserts that the formulæ usually given for the eastward and southward deviation during free fall, the resistance of the air being neglected, are wrong, the variation of (1) the centrifugal force, (2) the magnitude and direction of the weight during the fall, being generally neglected. If these are taken into account and the earth is taken as a homogeneous sphere, there is always a southward deviation given by—

$$(\omega^2 h^2 / 2g) \sin \lambda \cos \lambda \text{ or } (\omega^2 h^2 R / 2g^2) \sin^2 \lambda \cos \lambda,$$

according as the fall is in a well or from a tower. If the earth is taken as a prolate spheroid with semi-axes a and b , and if $k^2 \equiv a^2/b^2 - 1$, then these southerly deviations are respectively $(\omega^2 h^2 / 2g) \sin \lambda \cos \lambda (1 - gk^2/5b\omega^2)$ and $(k^2 h^2 / 10b) \sin \lambda \cos \lambda$. The last expression, with the values of a and b that correspond to the shape of the earth, is 100 times larger than the corresponding expression for the earth taken as spherical: but all these deviations are too small for practical measurement, being less than 0.1 mm. for a fall of 1 km. (The deviations are measured with respect to the vertical at the starting-point.) R. E. B.

509. *Deviation of Gravity Southwards and Curvature of the Lines of Force.* M. Fouché. (Comptes Rendus, 140. pp. 226-229, Jan. 28, 1905.)—A mathematical paper dealing with the modification of the earth's gravitational field owing to its rotation. The vertical component of the "centrifugal force," simply decreases the apparent weight of a body, but the horizontal component deflects a plumb-line to the south (in the northern hemisphere). The following expressions are found for δ , the deviation of a falling body, and for ρ , the radius of curvature of the earth's gravitational lines of force—

$$\delta = \frac{0.050}{24R} \sin \lambda \cos \lambda g t^4, \quad \frac{1}{\rho} = \frac{0.050}{gR} \sin \lambda \cos \lambda,$$

where R is the radius of curvature of the meridian, λ is the latitude, g the acceleration due to the earth, t the time of fall. [See preceding Abstract.] E. H. B.

510. *Brightness Variation in Globular Clusters.* C. D. Perrine. (Astrophys. Journ. 20. pp. 354-356, Dec., 1904.)—Photographs of eight of the best known globular star clusters obtained with the Crossley reflector at the Lick Observatory have been closely examined, and it has been found that in

general appearance all the clusters are very similar; they are of nearly the same angular dimensions, and the magnitudes of the component stars are remarkably alike. In each of these clusters practically all of the stars may be separated into two classes of magnitudes. About a third of the whole number lie between the eleventh and thirteenth photographic magnitudes, while almost all of the remainder are very faint, being about the sixteenth magnitude. This gives the appearance of two layers, one of bright stars superposed upon another of very faint stars. Such differentiation has previously been noticed by Palmer in the stars of the Hercules cluster (M 13), the counting of which gave 1,016 bright and 4,466 faint stars. Photographs of the cluster ω Centauri obtained at the Harvard College Observatory station at Arequipa show the same phenomenon. It may be noted that the clusters showing this peculiarity are widely distributed, covering 8 hours of right ascension and over 70 degrees of declination. Only one of them (N.G.C. 6656) is in the Milky Way. Two suggestions are put forward in explanation: (1) That it may be due to a difference in the size of the stars, or (2) to a difference in constitution or physical condition; but the absence of physical data as yet prevents any useful discussion of these hypotheses. C. P. B.

511. *Total Solar Eclipse Problems*. C. D. Perrine. (Astrophys. Journ. 20. pp. 881-887, Dec., 1904. Paper read before the St. Louis International Congress of Arts and Sciences, Sept. 28, 1904.)—A brief discussion of a few problems which it is hoped may be elucidated by the results of the approaching total solar eclipse in August, 1905. Special search is to be instituted for the possible existence of intra-Mercurial planets. At present there seems little probability that bodies of appreciable size exist, and the next eclipse ought to settle the question so far as objects brighter than the tenth photographic magnitude are concerned, which would correspond to a diam. of from 12-15 miles only. To explain the observed anomalies in the motion of Mercury about a million of such bodies would be requisite. The structure of the corona is but little understood, and may best be studied from photographs taken with long-focus cameras. The changes in the actual form of the corona from one eclipse to another show that the coronal matter is in motion, and the appearance of the streamers, with their evident connection in many instances with prominences and other eruptive phenomena on the sun's surface, strongly indicate motions away from the sun. It is also possible that radiation pressure may be concerned to a great extent in the outward transportation of the very minute particles of matter. In this connection, however, must be mentioned the forms of the hoods and the low velocities of the coronal matter, which indicate inward motions as well as outward. During the coming eclipse in August, 1905, special opportunities will be afforded of obtaining evidence on these points, as stations will be occupied along the eclipse track from the coast of Labrador to Egypt, between which there is a difference of two and one-half hours in the times of totality. During the last eclipse in 1901 the Fraunhofer lines were recorded to a distance of 45' from the solar limb, although then clouds were interposed, so that there are hopes of successful line-of-sight results from the photospheric light in the corona. The greater part of the light from the inner corona gives a spectrum without any visible trace of the Fraunhofer lines, and may be found to indicate the incandescence of solid or liquid matter. A small portion certainly gives a bright line spectrum, the origin of which is not yet determined. The bolometric results of 1900 appeared at variance to the idea of an incandescent inner corona, and it is important that

these be confirmed or otherwise. Photometric determination of the brightness of the coronal regions from the sun's limb outwards will be extremely important for the comparison of maximum and minimum coronas. C. P. B.

REFERENCES.

512. *Mercury Still.* J. Pollak. (Ann. d. Physik, 15. 5. pp. 1049-1050, Dec. 23, 1904.)—A very simple form of mercury still is described; it is easily set up, and requires little attention. The heating is performed electrically. S. G. S.

513. *Correction of a Clock by Means of the Gnomon.* G. Guglielmo. (Accad. Lincei, Atti, 13. pp. 525-533, Dec. 4, 1904.)—Having no instruments of precision available, the author investigated the question of the best form of gnomon to be used for the regulation of a standard clock. He adopts a small circular aperture in a horizontal screen, and traces on the floor the path of the image of the sun. The relation which the size of aperture bears to distance of screen for the production of the best definition of the image is discussed; and the author finds that with a diam. of 2 mm. and a screen at 4 m. distance the larger sun-spots are observable, while with a diam. of 4 mm. and a distance of 20 m. the smaller sun-spots can be seen. The tracing of the meridional line and the making of transit observations are described, and some of the results are given. These show that by this simple means the author has succeeded in correcting the clock within an error of 1 sec.

S. G. S.

514. *Diffusion of Liquids.* S. Leduc. (Comptes Rendus, 139. pp. 986-988, Dec. 5, 1904.)—An extension to diffusion of the notion of poles and fields of force. Each hypertonic and hypotonic point is regarded as a positive or a negative pole respectively, and these are the centres of the field of force, there being between the poles a dynamic action which produces kinetic effects in the same way as between magnetic or electric poles. The reciprocal actions of these poles enter into most living movements, in which the physical force at work is osmotic pressure, and the conception of fields of force explains the morphogenic actions of diffusion, which is able to produce all varieties of cellular forms. By the introduction into a solution of a coloured drop, representing a cellular nucleus, and two hypertonic or hypotonic drops, a succession of the figures and movements of karyokinetic division may be seen, following the same order as in a living cell. W. H. St.

515. *New Theory of Fog Formation.* H. Elias. (Monthly Weather Rev. 32. pp. 406-411, Sept., 1904.)—This is an extract and translation by F. W. Proctor from the author's book, "Die Entstehung und Auflösung des Nebels." The author recalls Homén's observations of 1893 to disprove the Davy-Dines theory of fog formation, and shows that the temperature equalisation by conduction proceeds at a much slower rate than the diffusion of water vapour. Referring then to observations made during balloon ascents from Berlin in 1901, he concludes that strong vertical differences of wind velocity prevail near the earth's surface when fogs form, and that in the absence of these differences only trifling fogs occur. One fog moved from Berlin east to Landsberg, 120 km. distant, at an average velocity of 5.5 m. per sec., which was the recorded wind velocity of the day. Most of the fogs of the North German lowlands result from the flowing away of a moist air current over the earth's surface, which has been cooled by radiation, in such a manner that the lower cold-air layers are tossed up by the billows which are formed at the same time, water being precipitated by the mixture of the upper and lower layers. H. B.

516. *Explosion of CS₂ with Air.* A. v. Oettingen and F. Blumbach. (Deutsch. Phys. Gesell., Verh. 7. 2. pp. 44-46, Jan. 30, 1905.)—The progress of such explosions in a eudiometer tube was examined photographically by aid of a revolving mirror. They were soundless except when the tube broke. The speed of propagation of the explosion varied with the mode of ignition, being smaller for oscillatory discharges than for intense sparks, and still smaller when a glowing wire was employed; further, the speed was in some cases constant throughout the explosion, and in others it gradually diminished. The speed of sound in the cold, dark gas was always less than 380 m. per sec., but in the hot, exploded mixture it varied between 400 and 3,000 m. per sec. according to the temperature of the mixture. R. E. B.

517. *Studies of Raindrops and Raindrop Phenomena.* W. A. Bentley. (Monthly Weather Rev. 32. pp. 450-456, Oct., 1904.)—The author has since 1899 been collecting raindrops in a tin tray, charged with fine flour, the tray being as a rule exposed for 4 sec. In this way he has obtained 344 sets of raindrop impressions from 70 storms, comprising 25 thunderstorms. Comparative experiments with measured drops, falling from glass pipettes and brooms, show that the flour pellets obtained closely resemble the respective drops when they are small; large drops give considerably flattened pellets. The sizes of the drops of the same and different storms vary strongly; large drops have a diam. of $\frac{1}{4}$ to $\frac{1}{2}$ in., small drops go down to $\frac{1}{32}$ in., and many to less than $\frac{1}{64}$ in. The author discusses the distribution of the drops (east, west, central portions of a shower) in storms, the influence of the kind of clouds, the evaporation during descent, &c., and gives illustrations. The initial drops are large; thunderstorms also give large drops, and scattered drops are again large. There are, on the other hand, as a rule, large numbers of almost microscopic drops. The author believes that falls essentially of small drops come from low altitude clouds, and that the large drops of heavy falls represent melted snow from higher altitudes. H. B.

518. *Mean Temperature of High Southern Latitudes.* J. Hann. (Nature, 71. p. 221, Jan. 5, 1905.)—With regard to the estimate by Krebs, the author points out that his own calculations for the new edition of his "Lehrbuch der Meteorologie" are probably too low, as the second year's records of the *Discovery* were not available at the time. H. B.

519. *Kite-flying on the Mediterranean and Atlantic.* H. Hergesell. (Comptes Rendus, 140. pp. 331-333, Jan. 30, 1905.)—Kites were sent up 25 times from the Prince of Monaco's yacht *Princess Alice*, in spring and summer, 1904, a maximum height of 4,500 m. being reached. Near Corsica, temperature and wind decreased much with the height, except in one case where the air grew warmer, owing probably to coastal influences. Over the Atlantic, between Oporto, the Canaries, and Azores, the temperature decreases with an adiabatic gradient, while the relative humidity increases from 70 to 100 per cent. in the first layer up to about 600 m. Then comes a sudden change; the thermometer rises by several degrees, the humidity drops to 50; this inversion layer reaches up to 1,000 m. In the third layer the temperature falls again, but the humidity is small; this layer extends up to 4,500 m. and higher. In the first layer the north-east trade blows with a speed of 7 m. per sec., rising to 19 m. near the islands in the south; it is not always noticeable on the surface; in the higher strata the wind goes round to the west generally *via* north; in the inversion layer it changes suddenly and drops; in the higher layer it blows mostly from north-west with a speed of 3 or 4 m. per sec.; a proper counter trade from south-east was not observed even near the Pic of Tenerife. Immediately above the sea-level the temperature fall is very marked; a night inversion, common on the Continent, was never noticed. H. B.

520. Indian and South African Rainfalls, 1892-1902. D. E. Hutchins. (*Nature*, 71, pp. 342-344, Feb. 9, 1905.)—The author, who has travelled in South Africa for twenty years, agrees with J. Eliot that variations in rainfall make themselves felt all over the Indo-Oceanic area, and repels J. R. Sutton's critique that the droughts of recent years had not affected South Africa. The summer rains certainly have their origin in the moist winds from the Indian Ocean, though the local winds may come from different directions. The author would go further than Eliot, and separate not only the winter, but also the spring and autumn rains from the summer rains. Particulars are given for several places, especially for the characteristic forest station at Evelyn Valley, founded by the author in 1887. The observations by H. G. Lyons on the level of Victoria Nyanza are also referred to. H. B.

521. Micrographic Study of the Cañon Diablo Meteorite. H. Moissan and F. Osmond. (*Comptes Rendus*, 140, pp. 71-75, Jan. 9, 1905.)—The apparently homogeneous iron of this meteorite [see Abstract No. 31 (1905)] contains irregular microscopic enclosures of iron and nickel phosphide and iron carbide in superposed layers. Those nodules which have not been exposed to external oxidation contain troilite, also surrounded by phosphide and carbide. In some portions the troilite has been oxidised, and has, apparently under the influence of considerable pressure, become laminated and of a schistic structure, layers of protoxide of iron alternating with troilite. There is, further, a fine porous border of unknown composition, and the whole structure is very irregular. H. Moissan (*Ibid.* pp. 405-406, Feb. 13.) The meteorite was found also to contain silicon carbide. H. B.

522. Radial Velocity of τ Vulpeculae. E. B. Frost. (*Astrophys. Journ.* 20, p. 296, Nov., 1904.)—Two spectrograms recently obtained with the Bruce spectrograph at the Yerkes Observatory indicate that this short-period variable star, which is of the same type as δ Cephei, also varies in its radial velocity. Both plates were obtained with the dispersion of a single prism, but in stars of this type the great number of lines available for measurement compensates for the lower dispersion. The extreme velocities indicated were +15 and -17 km. per sec. Predicted phases of the light-variation are: Minimum, July, 21 days 4 hours; maximum, July, 22 days 13 hours, G.M.T. Further observations were prevented by unfavourable weather conditions. C. P. B.

523. Ninth Satellite of Saturn. E. C. Pickering. (*Astrophys. Journ.* 20, pp. 357-358, Dec., 1904. Harvard College Observatory Circular, No. 87.)—The writer states that in future it is probable observations of the ninth satellite of Saturn, Phoebe, may be easily obtained when required, either for the purpose of correcting the present elements, or the study of the large and interesting perturbations to which it is subject. It can be observed visually with the largest refractors, and may doubtless be photographed with large reflectors. A table is given showing various positions of Phoebe determined by Bailey with the Bruce telescope, and Barnard with the Yerkes refractor, at epochs between June 18 and Sept. 12, 1904. For some unexplained reason Phoebe has not been found on the plates taken in July. C. P. B.

524. Co-ordination of Stellar Classifications. E. B. Frost. (*Astrophys. Journ.* 20, pp. 342-346, Dec., 1904. Paper read before the St. Louis International Congress of Arts and Sciences, Sept., 1904.)—The many schemes of classification of stellar spectra are discussed, and in urging the necessity of some standard system being adopted in the near future, it is suggested that the different electrical behaviour of the spectral lines might be the basis, but not temperature. Distinctions must not be based on variations in localised small sections of the spectrum, but must include all that can be examined; also studies of the energy distribution should be considered. C. P. B.

LIGHT.

525. *Theory of the Radiation of Moving Bodies.* F. Hasenöhr. (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 1039-1055, July, 1904.)—With the notation of Abstract No. 8218 (1904) it is here proved that the energy of radiation E within a closed volume at rest is increased in the ratio—

$$1:1 + \frac{1}{2}(1 + \sigma^2)/(1 - \sigma^2) - \frac{1}{2}\sigma^2 \log \{(1 + \sigma)/(1 - \sigma)\},$$

or approximately $1:1 + \frac{1}{2}\sigma^2$, if the volume is put into motion with speed σV , where V is the speed of light. This extra energy must be supplied from without, and the mass of the system is thus apparently increased by $8E/8V^2$. The substance of this paper and of the author's previous papers [see Abstracts Nos. 8218 and 8219 (1904)] is given in *Ann. d. Physik*, 15. 2. pp. 844-870, Oct., 1904, in a somewhat shortened form and with an entirely new setting. R. E. B.

526. *Sensitometry of Photographic Plates.* C. E. K. Mees and S. E. Sheppard. (Photographic Journ. 44. pp. 282-302; Discussion, pp. 302-303, Nov., 1904.)—Hurter and Driffield, whose method of determining sensitiveness has been nominally adopted by plate makers in this country, proved that the density was proportional to the mass of silver per sq. cm. of the plate, the density D being equal to $\log_e O$, where O , the opacity, may be measured photometrically as the reciprocal of the transparency. The authors have repeated, verified, and amplified a large number of Hurter and Driffield's fundamental experiments, and find, *e.g.*, that the inertia is a constant unaltered by the time of development, or the temperature or concentration of the developer (except with concentrated pyro developers). In some exceptional cases where inertia steadily decreases with long development, the effect is due to free potassium bromide in the plate. The effect produced by varying the reducer brings out two important groups of plates; in one the inertia is the same whatever reducer is employed, the other gives with ferrous oxalate about 1.75 times the inertia that it gives with organic developers. The effect found by Hurter and Driffield, that the addition of KBr produces an equal depression of densities throughout the scale, is seen by experiments on the outer parts of the curve to be due to the whole curve having been shifted sideways parallel to the exposure axis. Under the heading of sensitometry of orthochromatic plates, the precautions are described which were taken in standardising the acetylene burner used for exposures and to adjust its spectral conditions to those of daylight. The mathematical properties of a plate-curve are then dealt with. Starting from the Hurter and Driffield's equation $D = \gamma \log [p - (p-1)\beta^2]$, where p is the optical opacity of the unexposed plate to blue light and $\log \beta = -(1/p)$, it is shown that the tangent at the point of inflection of the curve cuts off the abscissa—

$$x = \log i - \sqrt{p} \times \log p/2(p - \sqrt{p}).$$

From this the constant i is found when a plate-curve is calculated. From this equation also the latitude of a plate is shown to be $0.625p$, the latitude being

defined as the ratio of the exposure at which over-exposure commences to that at which under-exposure ends, these two points being arbitrarily defined. Finally, equations and tables are given from which, by experiments on two plates, the development factor may be calculated, and a full bibliography is appended. [See also Abstract No. 2528 (1904).] G. E. A.

527. *Trichromatic Printing Inks.* C. G. Zander. (Photographic Journ. 44. pp. 811-817; Discussion, pp. 818-821, Dec., 1904.)—For typographical reproduction, positive printing blocks are generally made and printed in pigments which may, broadly speaking, be called complementary colours to the respective colour sensations. The ideal printing colours should have the following qualities: (1) The inks should each absorb one strip of the spectrum in the red, green, and violet respectively, and transmit the remainder unaffected, whilst the three absorption bands placed side by side should cover the whole of the spectrum; (2) the luminosity of the colours should be as high as possible; (3) the absorption bands should terminate abruptly, roughly at the D and F lines respectively. To produce the best possible results with permanent inks, it is necessary to first choose the inks and then to adapt the photographic process to the inks through combination of suitable colour filters and colour-sensitive plates. The multiplicity of filters in use, all more or less at variance with each other and with the scientific standard, makes it impossible to manufacture one ink to give satisfactory results all round. It would be most useful if the three-colour block-makers would agree on a standard of colours, both for filters and for inks. The author doubts whether three-colour printing will ever entirely supersede chromo-lithography, as there is a limited range of colour in the former. In the discussion, A. J. Newton disagreed with the suggestion that block-makers should first choose their inks, as he had found that it did not work well in practice. R. S. Clay was of opinion that the permanent commercial inks would give better results than the present theoretic inks. G. E. A.

528. *Photographic Photometry.* (Scientific American, 91. p. 488, Dec. 17, 1904.)—In a paper communicated by C. Cesari and C. Manicardi to the Royal Academy of Modena, the authors describe a photometric method which consists in determining chemically the weight of silver reduced on a sensitive plate by the action of light. The negative after exposure is treated with hot nitric acid, which destroys the gelatine and converts the silver into nitrate. The whole is then evaporated to dryness and the residuum taken up by dilute nitric acid. The solution thus obtained is well adapted for volumetric analysis, photometric results being obtained in about 50 min. Numerical results are given for several different luminous sources, the weight of silver measured being a few mgm. Panchromatic plates give the best results, but orthochromatic plates may be employed along with a yellow or green colour screen. G. E. A.

529. *Electric Double Refraction in Carbon Disulphide at Low Potentials.* G. W. Elmen. (Phys. Rev. 20. pp. 54-61, Jan., 1905. Ann. d. Physik. 16. 2. pp. 850-859, Feb. 24, 1906.)—Kerr gave the expression $\pm BP^2/l^2$ for the phase difference in the components of a ray of light passing through a medium subjected to an electric field at right angles to the direction of propagation, the components being taken in the plane of the electric field and at right angles to it, B is the electro-optic constant, P the p.d. between the electrodes, l the length of substance which

is rendered doubly refracting, and a the distance between the electrodes. Previous experimenters have been under the necessity of using very high p.d.'s in order to obtain sufficient double refraction to be measured by Babinet's compensator, and large errors have crept in, owing to the inexact determinations of these high p.d.'s. By using Brace's half-shade elliptical polariser and compensator [see Abstract No. 1018 (1904)], values of the phase difference as small as 0.0001λ could be measured, and hence high p.d.'s become unnecessary; the author employed p.d.'s varying from 200 to 1,400 volts. The author finds that for high voltages the curve connecting B and P is a straight line parallel to the P axis, and that it bends upwards when the p.d. per mm. falls to 200 volts; it then has the appearance of becoming asymptotic to the axis of B. *S. G. S.*

530. *New Method of Measurement of Stellar Spectra.* J. Hartmann. (Astrophys. Journ. 20. pp. 388-341, Dec., 1904. Paper read before the St. Louis International Congress of Arts and Sciences, Sept., 1904.)—After briefly recapitulating the principles of Vogel's two methods of coincidence reduction, and stating their weakness in that only a few of the many lines available are utilised for the determination of displacements, a method is described where the procedure depends on the simultaneous setting of numerous lines of one spectrum on the lines of another spectrum. The stellar spectrum is photographed as before, with a terrestrial comparison spectrum on either side. With the same spectrograph a solar spectrum is now photographed with the same comparison spectrum on either side of it. The two plates are placed in a specially constructed measuring machine, and the two spectra put in alignment. The solar spectrum is then moved by the screw so that the lines of the stellar spectrum coincide with those of the solar spectrum, and then so that the lines of the two comparison spectra agree. The difference of the settings will then give directly the required displacement. The process requires neither accurate knowledge of the wave-lengths nor extensive computation, but it is assumed that the lines have the same wave-lengths in both stellar and solar spectra. *C. P. B.*

531. *Influence of Light upon the Absorption and Electrical Conductivity of Fluorescent Solutions.* E. L. Nichols and E. Merritt. (Phys. Rev. 19. pp. 396-421, Dec., 1904.)—It is characteristic of a fluorescent substance that the light it emits during fluorescence is different in colour from that which it absorbs and to which its fluorescence is due. The two spectra overlap, and the fluorescence spectrum can be followed a considerable distance beyond the extreme infra edge of the absorption band. A fluorescent substance is thus able to emit light which under ordinary conditions it cannot absorb, and so offers an apparent exception to Kirchhoff's law. This makes it difficult to form a picture of the molecular processes that accompany absorption, but as absorption is usually measured when the substance is not fluorescing, it is possible that the absorption during fluorescence may be different. This is tested experimentally for three substances, viz., fluorescein in water, eosin in alcohol, and rezazurin in alcohol. The absorption is found to be increased in every case by fluorescence. It appears probable that the energy the solution absorbs reaches a saturation value as the intensity of the incident light is continually increased. The fluorescence absorption also shows a similar effect as the intensity of the fluorescence is increased. E. Wiedemann has suggested, as an explanation of phosphorescence and similar phenomena, that the incident light causes a definite chemical change

in the body, and that the gradual restoration of the original condition is accompanied by luminescence. A most probable change, the authors suggest, is dissociation; for it is scarcely to be doubted that absorption is due to resonance of the atoms or molecules, and this might be so violent as to cause disruption. This, in the case of fluorescent solutions, should cause an increase in electrical conductivity. This is found to be the case as the result of experiments on five substances dissolved in alcohol, viz., eosin, fluorescein, rhodamin, cyanin, and naphthalin red. The first gives an increase of 1.17 per cent., the last 0.057 per cent., the others amounts between these values. The heating effect of the incident radiation is eliminated by dispersing the rays and using those only which are most efficient. An alcoholic solution of fuchsin, which is not fluorescent, gives no such increase in conductivity. It is finally proved that the increase cannot be due to an alteration in the e.m.f. of polarisation of the electrodes. R. S. W.

532. *Radiation Phenomena of Hydrogen Peroxide.* L. Graetz. (Phys. Zeitschr. 5. pp. 688-690; Discussion, p. 690, Oct. 20, 1904. Paper read before the 76 Naturforscherversamml. zu Breslau, Sept. 21, 1904.)—The action of the species of radiation which appears to proceed from solutions of H_2O_2 and affects photographic plates is considered. The most remarkable fact connected with the phenomena is that objects which do not lie in the direct line between the H_2O_2 and the sensitive plate can appear as pictures on the latter. Thus an object placed behind a glass plate on which is placed a sensitive film is photographed by the rays coming from the H_2O_2 situated on the film side of the glass. Metals so placed on the far side of the plate away from the seat of the radiation appear bright on a dark ground. The action of ozone has been given by some as the cause of the phenomenon. The author does not agree with this hypothesis, but suggests that the action is due to differences of temperature. Very slight differences of temperature are able to manifest themselves in this way: a variation of $\frac{1}{10}^\circ$ can cause a picture on the sensitive film. Two pieces of iron, one at a temperature 1° higher, the other at 1° lower than the surrounding objects, when placed on the plate gave, the first a white the second a dark picture on the plate. J. J. S.

533. *Uranium Radiation.* S. Meyer and E. v. Schweidler. (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 1057-1070, July, 1904. From the Inst. für theoretische Physik and the II Physikal. Inst. der k.k. Univ. in Wien.)—It is pointed out that the choice of a solid uranium compound as a standard with which to compare other radio-active substances introduces indefiniteness on account of the different physical condition in which the standard substance may be taken. The authors therefore recommend that a solution be taken of definite concentration and thickness. It is proved that the activity is proportional to the surface area and rapidly increases with the thickness of the layer of solution tested. For a layer thicker than 1 cm. the radiation is constant. It increases rather faster than the density of the solution. They then separate the Ux from the nitrate and obtain the same result as Rutherford and Grier for the rise of activity of the latter, viz., it is found to reach half its maximum value in 22 days. The Ux is found to fall to half value in 2 days, instead of the 22 found by Rutherford. R. S. W.

534. *Radio-activity of Natural Waters.* B. B. Boltwood. (Amer. Journ. Sci. 18. pp. 878-887, Nov., 1904.)—A description is given of a method for the quantitative determination of the radio-active gas contained in a

water; a suggestion is made of a convenient standard for measurement and comparison; and experimental evidence as to the origin of the radio-active properties of natural waters is brought forward. The standard suggested and employed by the author is the quantity of radium emanation set free when a known weight of uranium in the form of a natural mineral is dissolved in a suitable reagent. The mineral taken was a pure uraninite from North Carolina, and it was dissolved in aqua regia. Details of the arrangements for collecting the gas from the waters examined are given, and also particulars of the results obtained. In order to obtain evidence as to the origin of the radio-active properties of mineral waters, a quantity of uranium minerals was pulverised and treated with water to obtain an artificial active water. From the results of the observations on this, it was seen that, by the action of cold pure water on uranium minerals, only a very slight trace of the radium contained in them is dissolved. The action of hot water is only slightly greater than that of cold water. Even brief contact with uranium minerals (or with gaseous mixtures containing the emanation) can impart to water very marked radio-active properties due to dissolved radium emanation. Hence it appears that all the radio-active properties of natural waters can be accounted for by contact with even a very minute trace of uranium minerals in the rocks and soil through which the waters percolate in their underground passage.

J. J. S.

REFERENCES.

535. *New Half-shade Polarimeter.* L. Zehnder. (Deutsch. Phys. Gesell., Verh. 6. 22. pp. 337-339, Nov. 30, 1904.)—To increase the accuracy of measurements on elliptically polarised light, the author uses along with a Biot-Babinet compensator a half-shade analyser which is a modification of Lippich's, one side of the half-shade diaphragm consisting of a nicol, the other side being occupied by a plane-parallel smoked or coloured glass plate. G. E. A.
536. *Photomicrographic Apparatus for Ultra-violet Rays.* A. Köhler and M. v. Rohr. (Zeitschr. Instrumentenk. 24. pp. 341-349, Dec., 1904.)—A full description, with constructional details and diagrams, of the microscope for ultra-violet rays. [See Abstract No. 51 (1905).] The Zeiss firm now make a set of these instruments, with quartz oculars and monochromatic objectives, to give magnifications ranging from 200 to 3,600. The arrangement includes an illuminating apparatus with collimator and quartz prisms for obtaining a monochromatic beam. G. E. A.
537. *Perspective Nature of Röntgen-ray Projection.* W. Cotton. (Röntgen Soc., Journ. 1. pp. 39-41, Dec., 1904.)—A further plea for the proper interpretation of Röntgen-ray photographs. [See Abstract No. 65 (1903).] The Röntgen-ray print as such should be discarded, and the negative viewed from its face exclusively. G. E. A.
538. *New Ultra-violet Glass.* J. H. Gardiner. (Röntgen Soc., Journ. 1. pp. 41-43; Discussion, pp. 43-45, Dec., 1904.)—The spectrographs given demonstrate the transparency to ultra-violet rays of the new Jena glass noticed in Abstract No. 512 (1904), the specimens tested consisting of one crown glass and three flints. One of the varieties of flint glass is particularly opaque to Röntgen rays. The glass melts easily, adheres to platinum, and can be blown and worked like ordinary glass. G. E. A.

- 539. Phosphorescent Printing.** J. H. Player. (Photographic Journ. 44. pp. 303-304; Discussion, p. 304, Nov., 1904.)—A uniformly translucent sheet of paper coated with luminous calcium sulphide is exposed to light and placed with the coating in close contact with the picture to be copied, being further exposed to gas-light for 5 to 10 min. The luminous paper is then removed and placed, phosphorescent film downwards, on a sheet of extra rapid bromide paper. The two papers are then heated at 120° F. in a frame in a dark box for 20 to 30 min., and finally developed in the ordinary way. In the discussion it was suggested that the image formed did not seem to be sharp and clear. G. E. A.
- 540. Reflection and Refraction at Naturally-produced Curved Surfaces.** J. J. Taudin Chabot. (Phys. Zeitschr. 5. pp. 823-825, Dec. 15, 1904.)—A continuation of the consideration of Abstract No. 2208 (1902). J. W. P.
- 541. Transparency of Argon for Ultra-violet Rays.** E. Meyer. (Deutsch. Phys. Gesell., Verh. 6. 24. pp. 362-364, Dec. 30, 1904. Phys. Inst. d. Univ., Berlin.)—The author has examined the absorption of ultra-violet light by argon mixed with nitrogen in Kreusler's photo-electric photometer. He failed to find any absorption. If it exists, it cannot in any part of the spectrum exceed 8.2 per cent. [See also Abstracts Nos. 66 (1902), and 899 and 1052 (1904).] E. E. F.
- 542. Interference Fringes Produced by Two Mirrors at Right Angles.** G. Lippmann. (Comptes Rendus, 140. pp. 21-22, Jan. 2, 1905.)—The rays from a luminous source are twice reflected from a system of two mirrors at right angles so as to form one image. If the angle of inclination of the mirrors is slightly increased, two images of the source are produced which act as two sources and furnish a system of fringes, with central white band, parallel to the intersection of the plane of the mirrors. The experiment may be done in several ways, e.g., by employing an illuminated slit and a right-angled prism. G. E. A.
- 543. Radio-activity of the Gases from the Carlsbad Springs.** A. Herrmann and F. Pesendorfer. (Phys. Zeitschr. 6. pp. 70-71, Feb. 1, 1905.)—The authors have investigated the radio-active qualities of the gases from the thermal springs, both photographically and electrometrically. Besides there being a marked radio-activity due to the gases other than the CO₂ forming the chief part of those collected, the presence of argon and helium was spectroscopically confirmed. L. H. W.
- 544. Do the N-rays Exist.** (Rev. Scientif. 2. pp. 545-552, Oct. 29; 590-591, Nov. 5; 620-625, Nov. 12; 656-660, Nov. 19; 682-686, Nov. 26; 718-722, Dec. 3; and pp. 752-754, Dec. 10, 1904.)—The first article is an editorial calling attention to the present uncertain feeling general with regard to the *n*-rays, and suggesting that in the interests of science, and particularly of French science, the question should be definitely settled. The following articles give the opinions of various physicists as to the existence or non-existence of the rays. Bichat, Gutton, and J. Meyer are the only ones who have been able to see all the phenomena described by Blondlot, and are convinced of the objective existence of the *n*-rays. d'Arsonval, Lambert, and Swyngedauw have been able to observe the most important effects, though they have not themselves gone in for the detailed study of the question. L. H. W.
- 545. Radium in the Carlsbad Springs.** J. Knett. (Akad. Wiss. Wien, Sitz. Ber. 118. 2a. pp. 753-762, June, 1904.)—An account is given of observations upon radio-active crystals of barium salts obtained from the Carlsbad waters, which furnish indirect evidence of the presence of radium in the springs. J. J. S.

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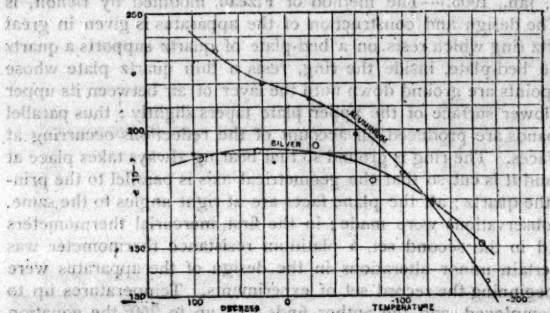
546. Thermometer Glass and the Annealing of Thermometers. G. Müller. (Zeitschr. Instrumentenk., Beih. 21. pp. 202-205, Nov. 1, 1904. Paper read before the Ilmenau Zweigverein d. Deutsch. Gesell. für Mechanik u. Optik at Jena, Aug. 6, 1904.)—Recent developments in the construction of precision thermometers are described, with special reference to Jena glasses which give reduced changes of zero and extend the use of thermometers to higher temperatures. In regard to the former, it is essential that the coefficients of the glass should always remain the same, and this must depend upon the constancy of composition of the glass. As regards the Jena thermometer glass 16^m, it has recently been shown that the depression of this glass is now less than it was formerly. This is in reality a grave disadvantage, as the use of the old data would lead to bad results. Recent observations on the rise of zero have also given results not quite in accord with earlier views. The coefficients of expansion and melting-points of the Jena glasses 16^m and 59^m are also required, particularly as the view of Schott, that thermometers of 59^m could be safely used up to temperatures of 550° C., has recently been found not to be quite correct, especially under the conditions of severe annealing that are now insisted upon. The proposal to make thermometers of the glass used for Jena combustion tubing also renders a determination of its thermal properties necessary. The author then deals with some minor points in the construction of these thermometers, and draws attention to the fact that the coating of white enamel put on some Jena thermometer glasses affects their thermal behaviour and appears to produce earlier softening, so that he suggests that the bulbs of thermometers should be made of the glass without the opal streak. He also points out that bulbs made of the combustion tube glass can be joined to tubes of 59^m so that the striking advantage of the opal streak need not be sacrificed. [See also Abstract No. 500 (1905).]

W. Ros.

547. Radiation Pyrometry. C. W. Waidner and G. K. Burgess. (National Bureau of Standards, Bull. 1. 2. pp. 189-254, Feb. 1, 1905. Phys. Rev. 19. pp. 422-451, Dec., 1904. Condensed.)—This is an investigation as to how far radiation pyrometry is practicable at the present time. An experimental comparison of some of the different methods proposed at various times is made, and a brief account of the principles involved is given. With the *le Chatelier* pyrometer they find that different observers can obtain results differing by about 1 per cent. The chief source of error in a *Wanner* instrument is the variation in the electric lamp, due to alterations in the current from the storage battery. This may cause an error of as much as 25° if the current is not kept constant by a rheostat to within 6 milliamps. With the *Holborn-Kurlbaum* form this difficulty also arises, but may be greatly mitigated if the lamp is first aged at a higher temperature than it is to be used for. Of these instruments, together with the *Morse* pyrometer and the *Féry* thermoelectric telescope, it is stated that no one of them can claim a decided superiority as to precision, certainty and ease of calibration, permanence of indications, and range. Temperature differences may be read much more accurately than 1 per cent, with the *Lummer-Kurlbaum* pyrometer to 2° at 1,500° C. The

black-body temperatures corresponding to known temperatures are found for various substances. For platinum the differences of these is less when green or blue light is used than when red. The polarisation of the light emitted by an incandescent body is found to be without influence in nearly every case when the Wanner pyrometer is used, and this is the only one in which, from the nature of the instrument, it could have any effect. R. S. W.

548. Coefficients of Linear Expansion at Low Temperatures. H. D. Ayres. (Phys. Rev. 20, pp. 38-51, Jan., 1905.)—The method of Fizeau is employed; the substance whose coefficient of expansion is required, being in the form of a ring which rests on a plate of black astronomical glass, and which carries a cover-plate with faces inclined at a small angle: the light reflected from the lower face of the cover-plate and from the upper face of the bed-plate produces the interference fringes. The interference apparatus is enclosed in a brass tube, which is cooled by the liquid air, the method of application of which is described. The cooling takes place so evenly that the travelling of the interference bands across the field of vision can be followed easily [see



Abstract No. 8212 (1904)]. The temperatures are deduced from measurements of the electrical resistance of a coil of fine copper wire, wound round the brass containing tube, the coil having previously been calibrated by Baly's curve for liquid air [see Abstract No. 1884 (1900)]. A Cooper Hewitt mercury lamp is used as a source of illumination, the green line being employed. The author discusses at length the influence of the change of density of the air on the wave-length of the light employed, and in order to investigate this effect a second set of experiments were made in vacuo. [See Abstract No. 565 (1905).] Tables of results for the coefficient of expansion of aluminium and silver at temperatures down to -185°C . are given, and are plotted on the accompanying curve: the ordinates are the coefficients multiplied by 10^7 .

S. G. S.

549. Melting-points of Minerals. A. Brun. (Archives des Sciences, 18, pp. 587-552, Dec., 1904. Société de physique et d'histoire naturelle de Genève, Dec. 1, 1904.)—The author maintains the accuracy of his previous work [Archives des Sciences (4), 18, April, 1902], in spite of the much lower values for the melting-points of certain silicates, published by Doelter [Thermak's Mitteilungen, p. 22, 1903] and Vogt [Die Silikatschmelzlösungen,

Christiania, 1908 and 1904. See Abstract No. 8040 (1904)]. His previous determinations were made with Seger cones. These are confirmed by determinations of temperature based on the calorimetric method (with platinum). The author points out that it is necessary to distinguish clearly between the crystal and its "glass." Thus, to take the case of anorthite as an example, he obtains the following data: Point No. 1: Temperature of destruction of the crystalline structure, $1,550^{\circ}$. Point No. 2: Minimum temperature of deformation of a thread of the glass, $1,088^{\circ}$ – $1,110^{\circ}$. Point No. 3: Temperature at which the glass begins to be cloudy, $1,144^{\circ}$. Point No. 3 bis: Temperature at which the glass becomes clearly crystalline, $1,210^{\circ}$. The "solidification-point" obtained by Vogt ($1,220^{\circ}$) corresponds, therefore, to No. 3 bis, whilst the values obtained by Doelter ($1,124^{\circ}$ and $1,190^{\circ}$) correspond to Points Nos. 2 and 3. [It is clear that the only thermodynamically definite temperature-point is that denoted above as No. 1. The other "points" involve the time-factor, and will vary with the experimental conditions (Tammann)]. F. G. D.

550. *Coefficient of Expansion of Quartz.* H. M. Randall. (Phys. Rev. 20. pp. 10–37, Jan., 1905.)—The method of Fizeau, modified by Benoit, is employed. The design and construction of the apparatus is given in great detail: a quartz ring which rests on a bed-plate of quartz supports a quartz plate. On the bed-plate, inside the ring, rests a thin quartz plate whose three resting points are ground down until the layer of air between its upper face and the lower surface of the upper plate tapers slightly; thus parallel interference bands are produced on account of the reflections occurring at these two surfaces. The ring is ground so that bearing always takes place at three points, and it is cut so that the geometrical axis is parallel to the principal axis of the quartz; all the plane faces are at right angles to the same. Two sets of observations were made; in the first, mercurial thermometers were used, and in the second set, a platinum resistance thermometer was employed. Certain minor alterations in the design of the apparatus were made before beginning the record set of experiments. Temperatures up to 500° C. were employed, and the author finds that up to 250° the equation $\alpha_t = (717.0 + 1.620t) \times 10^{-8}$ gives the coefficient of expansion of quartz with a high degree of accuracy, while from 250° to 470° the equation is $\alpha_t = [1125.0 + 1.65(t - 250) + 0.00566(t - 250)^2 + 0.0000184(t - 250)^3] \times 10^{-8}$. There is a rapid rise in the value of the coefficient of expansion in the neighbourhood of 500° , which renders it impracticable to employ an equation to represent the results. This sudden rise in the coefficient of expansion corresponds to that found by le Chatelier [see Abstracts Nos. 1020 (1903) and 818 (1904)]. The experimental errors throughout the course of the experiments in which the platinum resistance thermometer was employed affect the final result for the coefficient of expansion to the amount 6.29×10^{-8} . S. G. S.

551. *Ratio of the Mean Calorie to the 15°-Calorie.* U. Behn. (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 1. pp. 72–76, Jan. 12, 1905.)—Water, enclosed in a cylindrical vessel of Pt, of 20 c.cm. capacity, and heated to either 10° or 20° , was dropped into a Bunsen ice-calorimeter, and the results observed give 0.015460 gm. as the mass of mercury entering the calorimeter with a 15° calorie. The mean of Veltin's and of Schuller and Wartha's experiments give 0.015456 gm. with the mean calorie, so that the ratio of this calorie to the other is 0.9997. R. E. B.

552. *Contact Phenomena in Flames under the Influence of Solid Bodies.*

A. A. Baikoff. (Jurn. Russk. Fizik. Chimičesk. Obsčestva, 86. No. 8a. pp. 1112-1115, 1904.)—If in the colourless flame of an ordinary gas-burner metallic platinum be placed, this will assume a temperature which, under favourable circumstances, may exceed by some hundreds of degrees the temperature of the flame itself. This phenomenon can very readily be observed by means of the le Chatelier thermo-electrical pyrometer, if the thermoelement of the latter be heated in one case in the flame itself, and in the other enclosed in a thin envelope impervious to the gases. The most convenient envelope to use is a thin-walled quartz tube, sealed at one end. It is easy to show that the readings of the galvanometer are essentially different according as the junction is heated directly by the flame or enclosed in the quartz envelope. The author in the first place investigated the flame of a Bunsen burner. The height of the flame from the point of the burner was 21 cm., while the summit of the inner cone was at 5 cm. from the point. The following table records the readings of the pyrometer, located in the central part of the flame at variable heights from the point of the burner, either in the quartz envelope or without the same:—

Height in Cm.	Pyrometer Readings.		Difference.
	With Quartz Tube.	Without Quartz Tube.	
3.5	188 (846°)	220 (986°)	37 (138°)
5.0 (summit of inner cone)	253 (1,110)	324 (1,376)	71 (266)
6.5	258 (1,129)	321 (1,365)	63 (236)
8.0	256 (1,121)	324 (1,376)	68 (255)
10.0	229 (1,133)	328 (1,391)	99 (258)
12.0	254 (1,114)	317 (1,350)	63 (236)

From the above figures it will be inferred that the difference between the readings of the pyrometer upwards of the summit of the inner cone is fairly constant; taking this difference at 70 divisions, the pyrometer in the quartz tube shows a temperature 262° C. lower than without it. A similar experiment was carried out in a hydrogen flame with the following results: In the quartz tube the pyrometer reading was 245 mm. (1,080°), and without 303 mm. (1,297°), the difference thus being 58 mm., equivalent to 217° C. These experiments were repeated several times, and constantly led to identical results, after which experiments were made to show that neither heat radiation nor heat conduction played any considerable part in connection with the phenomenon in question. To eliminate the influence of heat radiation the flame of the gas-burner was included in a tube of iron or of clay, and observations made after heating these tubes very intensely. Experiments made under such conditions showed quite the same phenomena as those carried out on the unprotected flame. Further experiments indicate that the difference in pyrometer readings, with or without an envelope, depends neither on heat radiation nor on the properties of the gaseous medium in which the pyrometer is placed, and that the thermic conductivity of the envelope does not play any part in this phenomenon. As a result the conclusion is drawn that solid bodies (platinum, quartz, porcelain) placed in a flame assume a temperature of their own, differing from the temperature of the flame itself. The cause of this phenomenon is the contact influence of

solid bodies on the reaction of combustion. If the body displaces the limit of reaction towards the evolution of combustion products, the temperature will rise, while if the body give rise to an opposite reaction (dissociation) the temperature is lowered. The investigations are being continued.

A. G.

553. *Increase of Volume of a Liquid Casting, Saturated with Carbon in the Electric Furnace, at the Moment of Solidification.* H. Moissan. (Comptes Rendus, 140. pp. 185-192, Jan. 28, 1905.)—An iron casting made in a conical mould, like water frozen in a similar vessel, exhibits a central hollow, which suggests a contraction during solidification. That an expansion actually occurs was first shown in 1726 by Réaumur. Wrightson (Iron and Steel Inst. Journ., 1880) noted an expansion from 15.28 in. to 15.86 in. during the solidification of a sphere, and found that the density at the centre when cold was 6.95, but at the circumference 7.13—a result that was attributed to the internal pressure produced by expansion. This result was confirmed by the statement of Bell, that the solid always floats on the surface of the liquid. In a recent series of experiments the author found that Swedish iron melted by an electric current in a crucible of magnesia, and containing less than 1 per cent. of carbon, solidifies quietly without giving any indications of expansion. But when the iron is saturated with sugar charcoal, melted in a graphite crucible, and allowed to cool quietly in the air, the solidification of the surface is usually followed by an eruption of the liquid interior, which solidifies at once when the pressure is released. Occasionally no such eruption occurs, but the surface of the ingot is then rough and swollen, and a part of the carbon is in the form of diamond, testifying to the pressure existing in the interior. The instantaneous solidification of the released metal sometimes causes it to take a form strikingly similar to the lava plug of Mont Pélée. The carbon content of the specimens examined varied from 7.65 to 8.17 per cent. Incidentally it was noticed that the molten iron does not moisten the surface of the magnesia crucible, but in the graphite crucible the metal wets the crucible, and is drawn up the sides by capillary attraction. T. M. L.

554. *Investigations on the Law of Draper.* A. Amerio. (N. Cimento, 8. pp. 818-848, Nov., 1904. R. Istituto Tec. di Reggio, Calabria, Aug., 1904.)—Draper published, in 1847, the law that goes by his name, that all solid bodies, and probably also fused metals, become visible at one and the same temperature. The same result, according to the present writer, had been given sixty years earlier by Wedgwood. Other experiments, following those of Draper, led generally to the same result, until about 1887, when H. F. Weber threw doubts on the law, and more recent writers, ending with J. T. Bottomley in 1900 [see Abstract No. 1818 (1900)], have in general not confirmed Draper's law. According to the author, the reason for this disagreement is to be found in Kirchhoff's researches on the *absolutely black body*. And the fundamental law should be "that at equal temperatures the ratio between the emissive and the absorptive power is, in the case of all bodies, and for waves of all lengths, equal to the absorptive power of the *absolutely black body*." And he explains the agreement with Draper's law of the results of the earlier researches as being due to the fact that the experimenters were, without being aware of it, in effect dealing with *absolutely*, or *approximately*, black bodies. In the second part of the paper he describes certain experiments of his own, and as the result thereof arrives at the conclusions (1) that Draper's law does not exist; (2) radiating bodies become visible at a lower temperature the

greater their emissive power; (8) since the apparent emissive power of a body depends on the temperature of surrounding bodies, its temperature of visibility will vary as that varies, but as the variation of emissive power for luminous waves is invisible up to 800° , the temperatures of visibility observed in the experiments, are those at which the metals under investigation would become visible in free space, if the temperature of that space were the absolute zero. The variations of emissive power due to the surroundings should become sensible in the less refrangible part of the spectrum; and at low temperatures. (4) The experiments made by the writer with the sphere of hot brass are not sufficient to decide the question whether all radiations are found in the spectrum of a substance, or whether, on the other hand, the short waves become visible as the temperature rises; but they do show that when a body first becomes luminous there already exist in the spectrum radiations of the visible part.

S. H. B.

555. Saturation-pressure of a Vapour at a Curved Surface. A. A. Bacon. (Phys. Rev. 20. pp. 1-9, Jan., 1905.)—Experiments were made to test Kelvin's theoretical result. The final form of apparatus consisted of a closed glass vessel containing ether, into which dipped four glass tubes, 1.58 mm. in diam.; of these one was open at both ends so as to indicate the capillary rise, and the others were closed at the lower end and respectively filled to heights above, below, and equal to the level of the free surface in the open-ended tube. All air was pumped out of the vessel, which was then specially protected against variations of temperature and kept constantly under observation for nine months. The alterations of level in the tubes were very small in this time, but were in the right direction for agreement with the theory; thus showing that the process of adjustment to the condition of equilibrium is extremely small, so that the growth of drops in cloud formation is probably not due to the evaporation and subsequent condensation of small drops, but to their coalescence.

R. E. B.

556. The Most Probable Value of the Gas-constant R for Perfect Gases. D. Berthelot. (Zeitschr. Elektrochem. 10. pp. 621-629, Aug. 19, 1904. Translation.)—If pv be plotted as a function of p , the curve so obtained would be a straight line parallel to the axis of p if the gas obeyed the perfect gas laws. Practically it is a straight, or very nearly straight, line, making a certain angle with the axis of p from $p = 1$ atmosphere to $p = 0$ in the case of most gases at temperatures sufficiently removed from the critical temperature. In the case of the gases H_2 , N_2 , O_2 , and CO , the mean compressibility between 1 and 2 atmospheres is practically the same as the mean compressibility between 0 and 1 atmosphere (temperature $0^{\circ} C.$). In the case of CO_2 , N_2O , HCl , C_2H_6 , and SO_2 , the compressibility between the lower pressure limits is a little smaller. Proceeding in this way, and using the data of various investigators (Leduc and Sacerdote, Chappuis, Rayleigh, &c.), the most probable found for the volume of 1 gm.-mol. of a perfect gas at $0^{\circ} C.$ and 760 mm. Hg, and at sea-level in latitude 45° is 22.412 litres. The value of R is 0.08207, this value being probably correct to about 1 part in 8,000. The unit of volume is the litre, and the unit of pressure 760 mm. of Hg (at $0^{\circ} C.$) at sea-level in latitude 45° . The value found for the melting-point of ice is 273.09 in the absolute scale of the perfect gas thermometer.

F. G. D.

557. Variation of the Quantity b of the Equation of State considered as an Apparent Compression of the Molecule. J. D. van der Waals. (Archives

Néerlandaises, 9. pp. 381-388, 1904.)—A discussion of the variation of b regarded as due to an inter-penetration of the molecular spheres of action. Retaining the first two terms in the series $b = b_1 \{ 1 - a(b_1/v) + \beta(b_1/v)^2 \dots \}$ where b_1 is the value of b for a perfect gas, and employing the relations $(dp/dv)_T = (d^2p/dv^2)_T = 0$, which hold for the critical state and the experimental result $(pv/RT)_c = 0.275$, it is found that $\alpha = 0.861$. The corresponding calculation is carried out for the case when three terms of the foregoing series are retained. No definite conclusions appear to be arrived at.

F. G. D.

558. *Verifications of a Recent Formula of van der Waals.* J. J. van Laar. (Archives Néerlandaises, 9. pp. 389-417, 1904.)—The formula referred to is the equation $(b - b_0)/(v - b) = 1 - \{ (b - b_0)/(b_1 - b_0) \}^2$ for a diatomic gas, in which b_0 = smallest value of b (contact of the atoms), and b_1 is the limiting value attained when the volume becomes infinitely great. The quantity b is thus represented as a function of the volume. The equation appears to represent experimental data fairly well in the case of hydrogen. It is found that $(b_1 - b_0)^3$ is proportional to the absolute temperature. The second portion of the paper is concerned with calculations relating to the specific heats of solids and liquids.

F. G. D.

559. *Mixtures of Methyl Chloride and Carbon Dioxide and the Law of Corresponding States.* H. Kamerlingh Onnes and C. Zakrzewski. (Konink. Akad. Wetensch. Amsterdam, Versl. 18. pp. 207-211, July 18; p. 823, Oct. 6; and pp. 380-386, Nov. 9, 1904. Proc. 7. pp. 285-290, Nov. 23, and pp. 377-382, Dec. 21, 1904. Physical Laboratory, Leiden.)—The first part deals with the determination of the second virial coefficient by compressibility measurements. When calculated as a quadratic function of x the differences are found to be small. The general second virial coefficient VI.2., obtained by including isopentane, gives another set of values. These differ more for methyl chloride than the above from the experimental values. The second part deals with coexistent phases at low temperatures. At -25°C . the initial pressure of condensation with $x = 0.5042$ is 156.0. Owing to the form of the apparatus, the final pressure had to be determined at -38.5° , and is found to be 6.18 atmospheres, corresponding to $x = 0.5084$. The discussion shows that with liquid densities and low temperatures there are marked divergences from the law of corresponding states.

H. H. F. H.

560. *Free Energy of Formation.* H. v. Jüptner. (Zeitschr. Anorg. Chem. 42. 2. pp. 235-249, Nov. 21, 1904. K.K. techn. Hochschule, Wien.)—The author refers to his former work [see Abstracts Nos. 2281 and 2642 (1904)], and adds numbers for reactions not yet given. With the help of the calculated numbers, he gives tables of values of Q_r . He finds that for $\text{H}_2 + \text{O} = \text{H}_2\text{O}$ this is a maximum at 289° , and has the same value at 852° as at -278° , while the decrease of free energy, A_r , diminishes with rise of temperature, becomes zero at $2,000^\circ$ absolute, and negative at still higher temperatures. For $\text{CO} + \text{O} = \text{CO}_2$, Q_r has its maximum value at 402° absolute, is the same at 804° absolute as at 0° absolute, and becomes zero at $5,000^\circ$ and negative at temperatures beyond this; A_r diminishes continuously as the temperature rises, becomes zero at $2,000^\circ$ and then negative. For $\text{C} + \text{O} = \text{CO}$, Q_r increases with rise of temperature, and A_r also increases at first, but reaches a

maximum at $1,280^\circ$ and then diminishes. It is remarkable that between 0° and $1,200^\circ$ the A_T in CO is greater than Q_T . The maximum Q_T for $C + O_2 = CO_2$ is at about $2,727^\circ$, while A_T diminishes with rise of temperature and becomes zero at $3,000^\circ$. In the reaction $N + O = NO$, Q_T is independent of the temperature, whilst A_T diminishes with rise of temperature. In the case of $N + H_2 = NH_3$, Q_T possesses a maximum, but A_T falls as far as the maximum A_T rises from $8,100^\circ$ absolute onward to become greater than Q_T . In $2CO = CO_2 + C$, Q_T has its maximum value at 177° absolute, whilst A_T falls continuously. With $CO_2 + H_2 = CO + H_2O$, Q_T increases steadily as the temperature rises, and up to $5,000^\circ$ absolute A_T is greater than Q_T . In $H_2O + C = CO + H_2$, Q_T is negative, has a minimum value at 212° absolute, and from there continuously increases; A_T increases as the temperature rises. For $2H_2O + C = CO_2 + 2H_2$, Q_T is at first negative, possesses a minimum value at 262° C., becomes zero at $2,670^\circ$ absolute, and beyond that positive; A_T is also negative at first, and becomes zero at about 750° absolute, and positive at still higher temperatures; it reaches a maximum at about $5,000^\circ$ absolute, while at about $4,600^\circ$ absolute it has the same value as Q_T . These data show that the temperatures at which Q_T and A_T become zero are different. Only in one case is Q_T constant, this being due to the fact that equal volumes of diatomic gases exist before and after the reaction; in all other cases a maximum or minimum is present. For many reactions the change of free energy is an almost rectilinear function of the temperature. The author also discusses the different cases of the thermodynamic equation, $U = A - Q$ or $A - U = Q$. T. H. P.

561. *Molecular Attraction*. III. J. E. Mills. (Journ. Phys. Chem. 8. pp. 598-638, Dec., 1904.)—The author discusses several facts which bear on the results given in his last paper [see Abstract No. 2931 (1904)], and which confirm the law of attraction by showing that the equation—

$$(L - E_1)/(\sqrt[3]{d} - \sqrt[3]{D}) = a \text{ constant,}$$

holds for normally constituted substances, and is applicable with equal exactness in the immediate neighbourhood of the critical temperature. On investigating the equation, $L = 2RT \log_e (d/D)$, proposed by Crompton, it is found that at low temperatures, where the vapour pressure is small, the results given by the equation are invariably too large, and usually considerably so, but at higher temperatures correct results are obtained. At the critical temperature Crompton's equation gives results confirming the law of attraction assumed by the author. Within certain limits $\partial P/\partial T = (287500/m) (\log (V/v)/V - v)$. At the critical temperature the following relations hold:—

$$P = (\partial P/\partial T)T - (10471\mu/V^{4/3}), \quad \partial P/\partial T = 124860/mV, \quad m\mu'\sqrt[3]{d}/T = a \text{ constant.}$$

At the critical volume, the " a " of the equation, $p = bT - a$, becomes identical with the term $10471\mu/V^{4/3}$. The author also discusses the variation of the latent heat of vaporisation with the temperature. T. H. P.

562. *Kinetics of Adiabatic Reactions*. G. Bredig and F. Epstein. (Zeitschr. Anorg. Chem. 42. 3, pp. 341-352, Dec. 10, 1904. Chem. Universitätslaborat., Heidelberg, Aug., 1904.)—Considering a reaction of the n th order, the velocity-equation is $dx/dz = k_{T_x}(a - x)^n$, where z = time and k_{T_x} is the velocity-coefficient corresponding to the temperature T_x . In a heat-

isolated system the temperature will be a definite function of x (the amount of substance transformed), so that we can use the symbol T_x to indicate the temperature corresponding to a definite point (x) in the course of the reaction.

Putting $k_{T_x} = e^{\frac{A}{T_x}}$ (van't Hoff-Arrhenius), we have $\frac{dx}{dz} = e^{\frac{A}{T_x}(a-x)^n}$. Since the system is heat isolated, $qb\delta x = w\delta T_x$, where q = heat of reaction per gm. formula-weight, b = number of litres of homogeneous reacting-system contained in the apparatus, w = thermal capacity of system. Assuming as a first approximation that q and w are constant, we obtain the "calorimetric equation," $(a-x)qb = w(T_e - T_x)$, where T_e = end-temperature, corresponding to $x = a$. The constants b and w depend in general not only on the nature of the chemical system, but also on the experimental conditions. Differentiation of the calorimetric equation with respect to time gives $dx/dz = (w/qb)(dT_x/dz)$, which, substituted in the original velocity-equation, leads to the temperature-time equation—

$$\frac{dT_x}{dz} = e^{\frac{A}{T_x}} \left(\frac{w}{qb}\right)^{n-1} (T_e - T_x)^n.$$

Thus for a reaction of the first order ($n = 1$) we have—

$$z_2 - z_1 = e^{-\frac{A}{T_e}} \int_{T_1}^{T_2} \frac{e^{\frac{A}{T_x}}}{T_e - T_x} dT_x.$$

This integral is best evaluated for numerical calculation by an application of Simpson's rule to successive small portions of the time-temperature curve. The foregoing result has been experimentally verified in the case of the catalytic decomposition of hydrogen peroxide in the presence of the iodide ion. The reaction has been already shown by Bredig and Walton [see Abstract No. 211 (1904)] to obey a unimolecular velocity-equation. The reaction-system was contained in a Dewar-Weinhold vacuum vessel. The following is a sample of the results obtained:—

T_x	27° + 26.25°	33.75°	38.25°	36.75°	40.35°	43.75°	47.25°	50.75°	54.25°
Time in	Observed 0	116	212	299	383	464	533	656	808
Seconds (z).	Calculated 0	116	213	302	385	465	547	643	796

The second portion of the paper contains an extension of the theory, in which the assumption of the constancy of w and q is dropped, and more general formulæ obtained. Reference is made to the paper of Petrovitch (Comptes Rendus, 124, p. 1344, 1897), in which the velocity of adiabatic reactions is also dealt with, but in an erroneous manner. F. G. D.

REFERENCES.

563. *Distribution of Air in an Air Liquefier.* W. P. Bradley and C. F. Hale. (Phys. Rev. 19, pp. 387-395, Dec., 1904. Contribution from the Cryogenic Laboratory of Wesleyan University.)—By means of platinum thermometers the temperature of the air which escapes from the valve is obtained just below the valve, and at different points in the ascending column. The rapidity with which thermal interchange takes place between the outflowing and inflowing gases is very strikingly brought out. Curves are given showing the temperature at different heights and for different air pressures. The conclusion is drawn that liquefaction does not occur at any point above the valve. R. S. W.

564. *Siemens and Halske Registering Pyrometer.* (Zeitschr. Instrumentenk. 24. pp. 350-357, Dec., 1904.)—The temperature effect on a thermo-element is indicated by a moving-coil instrument, the pointer of which is caused to register its position on a moving strip of paper. A clockwork unwinds the paper below the pointer. Above the latter is a stirrup, in the form of the arc described by the end of the pointer. A ratchet-wheel actuates a lever which makes the stirrup periodically press the end of the pointer, on which is a style, against the paper. This brings the paper into contact with an ink ribbon, a blue dot being registered. The paper is made to move at about 2 cm. per hour, the registering period being 1 min. in certain cases. A transparent scale in front allows the registered temperatures to be read off. G. E. A.

565. *Coefficients of Expansion at Low Temperatures.* J. S. Shearer. (Phys. Rev. 20. pp. 52-53, Jan., 1905.)—The apparatus constructed by H. D. Ayres [see Abstract No. 548 (1905)], was used by F. M. Simpson in making experiments *in vacuo*, the object being to test the applicability of Pulfrich's formula for changes of refractive index of air at low temperatures. The results obtained agree very well with those of Ayres, which were made in air at a pressure of 74 cm. of mercury, and in which the validity of Pulfrich's formula was assumed. Hence this assumption was justified. S. G. S.

566. *Regulating Tube for a Thermostat.* O. Dony-Hénault. (Zeitschr. Elektrochem. 11. pp. 3-5, Jan. 6, 1905. Laborat. de l'Inst. Solvay, Brussels. Translation from the French.)—Assisted by Querton, the author has devised a regulating tube which is an improvement on that of Ostwald-Luther, and also on forms proposed by Lumière. The tube is bent several times, and toluol is intercepted in one limb between solution of sodium chloride, beyond which the tube further contains mercury. The temperature has been kept steady within 0.05° for 12 days; the mean temperature of the thermostat would, however, sink by 0.027° only if the temperature of the room rose 2.5° C. The apparatus can be obtained from F. Huguershoff in Leipzig. H. B.

567. *Determination of Melting-points at High Temperatures.* K. Arndt. (Verein zur Beförd. d. Gewerbebeisses, Verhandl. pp. 265-298, Sept., 1904.)—After pointing out that the physico-chemical Tables of Landolt-Björnstein give for the melting-points of the elements many old and widely varying values, the author gives an exhaustive review of the work done in this domain during the last ten years, but restricted to pure metals with melting-points over 500° C. L. H. W.

568. *Specific Heats of CO_2 and Isopentane.* E. Mathias. (Journ. de Physique, 3. pp. 939-946, Dec., 1904.)—The author points out that Dieterici's method of experimenting [see Abstract No. 1692 (1904)] had been previously suggested and carried out by himself [see Abstracts Nos. 14 (1897) and 1440 (1900)] and in greater detail; and he shows that Dieterici's results are not trustworthy, as the substances were studied only in the liquid state, so that there was no check against the accumulation of errors in the necessary trains of calculations. [The author himself seems to be in error in his calculation of the isometric specific heat of vapours, which he calculates as if the vapours could alter isometrically and yet remain saturated and dry.] R. E. B.

569. *Reversible Processes of Maximum Efficiency.* S. Valentiner. (Ann. d. Physik, 15. 4. pp. 829-835, Dec. 6, 1904.)—The author has apparently discovered for himself the proposition due to Rankine that the adiabatic processes in a Carnot's cycle may be replaced by processes which are isodiabatic to each other without the efficiency of the cycle being diminished, provided that the regeneration is perfect. He seems, however, to think that Q/t represents the same thing as $\int dQ/t$, for he uses the former throughout as if it were the latter. R. E. B.

SOUND.

570. Demonstration of Stationary Sound Waves. H. Rubens. (Deutsch. Phys. Gesell., Verh. 6, 24, pp. 851-855, Dec. 80, 1904.)—A brass tube 4 m. long and 8 cm. wide is provided with a row of 100 jet holes about 2 mm. wide. Coal gas is introduced near one end, and of the two ends of the brass tube one is closed by means of a brass lid and the other by means of a brass diaphragm. A sounding organ-pipe, bell, or tuning-fork is placed near the rubber diaphragm, and the jets are lighted. While the sound continues, the jets mark out stationary waves by their variations in brightness, the wavelengths thus marked out being those of the notes sounded. When the sound is strong, the maxima are at the nodes or points of maximum variation of pressure. When the sound is feeble, the phenomenon is reversed, and the maximum brightness shifts to the centres of ventral segments or points of maximum motion. In the former case the flames are oscillating, in the latter they are steady. In either case, the amount of gas consumed is greater when the sound is being produced than when there is silence. E. E. F.

571. Theory of Rubens' Sound-Wave Tube. O. Krigar-Menzel. (Deutsch. Phys. Gesell., Verh. 6, 24, pp. 856-861, Dec. 80, 1904.)—The author attempts to explain the second condition described by Rubens [see preceding Abstract] as exhibiting maxima of luminosity at the points of maximum motion and minimum change of pressure. He traces this effect to a dynamical pressure of vortices produced in the tube by the internal friction of the gas. This internal friction prevents the peripheral portions of the gaseous column from acquiring the full to-and-fro motion which the middle portions execute at the ventral segments under the influence of the sound wave. The excess of pressure may be estimated by the rule which gives the difference between the hydrostatic and the hydrodynamical pressure as equal to half the density multiplied by the square of the velocity of the freely moving gas. The author calculates the maximum velocity of the axial portions of the gas as 251.5 cm. per sec. The oscillation of pressure at the nodes amounts to 6,080 dynes per sq. cm., whereas the hydrodynamical excess is only 1/400 of that amount. Hence, when the sound is loud the latter is completely masked, and the maximum luminosity occurs at the nodes. At low intensities, however, the hydrodynamical pressure is brought into play, and the maxima shift to the ventral segments. E. E. F.

REFERENCES.

572. Sound Waves Produced by Electric Sparks. M. Toepler. (Ann. d. Physik, 14, 4, pp. 888-842, Aug. 2, 1904. Phys. Inst. d. techn. Hochschule, Dresden, May 21, 1904.)—A description of a method by which the sound wave may be rendered objectively visible. The Schlieren arrangement of condensers, spark-gap, induction coil, and lenses is employed. J. W. P.

573. Resonance. T. Terada. (Mathematical and Physical Soc., Tokyo, 2, 16, pp. 211-216, 1904.)—When a plate is approached gradually to the front of a resonance box, the resonance is increased, attaining a maximum at a certain distance, beyond which it falls off rather abruptly. Experiments in illustration and a mathematical analysis are given. J. W. P.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

574. *Electron Theory*. A. Sommerfeld. (Gesell. Wiss. Göttingen, Nachr., Mach.-Phys. Klasse, 5. pp. 368-439, Dec., 1904.)—A continuation of the paper dealt with in Abstract No. 2254 (1904). The present highly analytical paper deals with the bases for the general dynamics of the electrons. Among the topics treated are the following: Calculation of the mechanical force, That part of the force which produces translation, The turning couple, Speeds exceeding that of light, Rectilinear motion, Stationary motion with speeds below and above that of light, Quasi-stationary motion, Electromagnetic mass, Uniform acceleration, Uniform motion in a circle, Electromagnetic centrifugal force and transversal mass, Force and couple for pure rotation, Electromagnetic moment of inertia, and Free rotatory vibrations. E. H. B.

575. *Simplified Deduction of Field and Forces of an Electron*. A. Sommerfeld. (Konink. Akad. Wetensch. Amsterdam, Versl. 13. pp. 431-452, Dec. 7, 1904. Proc. 7. pp. 846-887, Dec. 21, 1904.)—The author previously gave [see Abstract No. 2254 (1904)] a general representation of the field of an electron, moving in any given way, which seems simpler than the other formulæ hitherto known, based on the work of H. A. Lorentz. The simplification in question lies in the fact that, to express the potentials, only a simple integral was required, extending over the past time and containing only the varying distances of the point in question from the centre of the electron, supposed to be spherical; whereas the other formulæ hitherto known, are double or triple integrals, extending over the space, charged with electricity, and containing the distance of the point in question from the position of the charge at a certain former time. A further simplification is made in the present paper. Instead of starting with an elaborate Fourier integral, a simpler method is employed, using only Green's theorem. In this way the potential is represented at the outset by a quadruple integral, one integration extending over the time, the others over the space occupied by the charge. Here the ways divide. (a) The integration over the time may be first calculated; this leads to Lorentz's representation. Then the integration over the charge assumes a complicated form, relating not to simultaneous positions of the elements of the charge, but to positions occupied by such element at a certain former time, or, in other words, relating not to the real shape of the electron, but to a deformed one. (b) The integration over the charge may be first taken. This leads to the author's formulæ. Then in general cases of motion all that is needed is the evaluation of a comparatively simple integral. The analysis is then developed along these lines and applied to various problems, viz., the determination of the field at a great distance from the electron, to the case of stationary motion, especially with a velocity exceeding that of light. Also a detailed study is given of the field in the neighbourhood of the shadow of motion, a region which is defined as follows: Let the present position of the electron be O and a previous position P. Round every point P of the path a sphere may be described by radius cr , where c is the speed of

light and τ denotes the time in which the electron moves from P to O. The envelope of these spheres defines the "shadow of motion." [It is obviously analogous to the "breast wave" shown on the photographs of flying bullets by C. V. Boys.] It is shown that the stationary motion with a velocity less than that of light is in every case a possible free motion of an electron. The value is then deduced of the force needed to maintain a motion of a *bodily* (volume) charge, with a speed v , exceeding that of light, c . This force is distinctly finite, even in case of infinite velocity, being given by—

$$4\pi F = - (9/4) \left\{ 1 - (c^2/v^2) \right\} (e^2/a^2)$$

and so for $v = \infty$, we have—

$$F = - (1/4\pi) (9/4) (e^2/a^2).$$

This equals the attraction of two point charges each $3e/2$ at the distance a , according to Coulomb's law. On the other hand, it is shown that the motion of a *surface*-charge with a speed exceeding that of light is actually impossible, requiring continually an infinite supply of force. Indeed, if the charge is concentrated at one point, the force is infinite for velocities less than that of light. E. H. B.

576. *On Helicoidal Potential Functions.* G. Picciati. (Accad. Lincei, Atti, 18, pp. 595-608, Dec. 18, 1904.)—In ordinary cylindrical co-ordinates ρ, θ, z , the potential of an indefinite straight line parallel to z and charged with electricity of density k per unit of length is given by—

$$\phi = -2k \log \sqrt{\rho^2 + \rho_1^2 - 2\rho\rho_1 \cos \theta - \theta_1},$$

where ρ_1, θ_1 are the values of ρ, θ which correspond to the given line. This the writer develops into—

$$\phi = -2k \left(\log \rho_1 - \sum_{n=1}^{\infty} \frac{1}{n} \frac{\rho^n}{\rho_1^n} \cos n\theta - \theta_1 \right) \text{ if } \rho < \rho_1$$

and—

$$\phi = -2k \left(\log \rho - \sum_{n=1}^{\infty} \frac{1}{n} \frac{\rho_1^n}{\rho^n} \cos n\theta - \theta_1 \right) \text{ if } \rho > \rho_1.$$

To express the potential due to an indefinite helix traced on a cylinder whose axis is parallel to z , he uses helicoidal co-ordinates transformed from Cartesians by the formulæ $x = \rho_1 \cos \rho_2, y = \rho_1 \sin \rho_2, z = \rho_2 + m\rho_2$, in which m is a factor denoting the step of the helix, which, in the present paper, is taken as unity. The potential due to that portion of the helix which lies between $\rho_2 = -\theta_1$ and $\rho_2 = \theta_1$, is found for the case $\rho_2 = 0$ to be of the form—

$$\phi = k \int_{-\theta_1}^{\theta_1} \frac{\sqrt{1+R^2}}{r} d\rho_2,$$

r being the distance from a point in the helix to the point whose potential is required. The mathematics are worked out at considerable length from these data, and the theory extended to the case of an indefinite helix, and the case of m not being unity is considered. The writer then discusses the problem of an indefinite cylinder of circular section, of homogeneous conducting substance connected to earth, within which are v indefinite helices each of step m and linear density k , and it is required to find the potential of the electricity induced on the cylinder. S. H. B.

577. *Motion of Electrons in Metals.* H. A. Lorentz. (Konink. Akad. Wetensch. Amsterdam, Versl. 18. pp. 498-508, Jan. 5, 1905. Proc. 7. pp. 438-453, Jan. 25, 1905.)—Riecke, Drude, and J. J. Thomson [see Abstracts Nos. 299 and 1024 (1899), and 1276 and 2200 (1900)] have shown that the conductivity of metals for heat and electricity, the thermoelectric currents, the Thomson effect, the Hall effect, and allied phenomena may be explained on the hypothesis that a metal contains a large number of free electrons, and that these particles, taking part in the heat-motion of the body, move to and fro with a speed depending on the temperature. The present paper deals with the same subject but with a somewhat different treatment, founded, of course, on the statistical methods of Maxwell and Boltzmann. Expressions are obtained for the electric and thermal conductivities differing from Drude's only in the values of their numerical coefficients. E. H. B.

DISCHARGE AND OSCILLATIONS.

578. *Special Forms of the Electric Discharge Produced by a Holtz Machine.* L. Amaduzzi. (Atti dell' Assoc. Elettr. Ital. 8. pp. 520-528, Sept.-Oct., 1904.)—The discharge between a disc and a point varies in character as the spark-gap is increased in length, but the variation is far from regular. The author observes two types of discharge—one a continuous violet glow, and the other a fine band which wavers considerably. He finds that for any length of spark the discharge is liable to change at any moment from one kind to the other. In the case of the band discharge the sound emitted is of a particularly pure tone, the pitch of which depends on the length of gap and the capacity in the circuit. The author describes various changes in the discharge that may be brought about by suddenly altering the p.d. by connecting one terminal of a condenser to some point of the circuit, the other terminal being earthed. An experiment is also described in which a Crookes tube is placed as shunt across the machine terminals, the point and disc being drawn apart further than the sparking distance. On the experimenter's hand being brought near the tube, sparks begin to pass between the point and disc, and these cease as soon as the hand is withdrawn. The paper is illustrated with numerous photographs of the discharges. S. G. S.

579. *Genesis of Ions by the Motion of Ions.* J. S. Townsend and H. E. Hurst. (Phil. Mag. 8. pp. 788-752, Dec., 1904.)—Previous research has explained the principles and methods employed [see Abstracts Nos. 1511 (1908) and 144 (1904)]. Hydrogen and air are again the gases used, and the pressures are now greater; up to 6 mm. of mercury with air and up to 20 mm. with hydrogen. In plotting from experiment, sparking potential in volts (x) against the product axp , where a is sparking distance in cm, and p pressure of the gas in mm., the author finds that after a value of $x=300$, x is nearly proportional to axp . When $axp=1$ there is in the case of hydrogen a minimum point in the curve which is there convex to the axis axp . The author also finds that his ionisation theory of the discharge produces curves practically identical with the experimental ones. P. E. S.

580. *Discharge by a Ruhmkorff Coil.* L. Amaduzzi. (N. Cimento, 8. pp. 425-427, Dec., 1904.)—The coil is operated by an alternating current at 110 volts. The primary is in series with a coil of variable inductance, a copper

sulphate solution rheostat, and a Wehnelt interrupter; the secondary is in series with a spinterometer having a carbon disc and a zinc point as electrodes. On adjusting the spark-gap to a convenient length and closing the primary circuit, a flame discharge is produced; this, however, becomes a line discharge on increasing the resistance by drawing apart the plates of the rheostat. With further increase in the resistance the spark ceases, and on proceeding further the spark recommences in the flame form. On again increasing the resistance the discharge again ceases. If instead of drawing the electrodes of the rheostat apart, they are gradually raised from the solution, the flame discharge changes to the spark and then ceases altogether. Then the spark reappears, and on proceeding further many alternations of spark and no discharge follow. Similar effects are produced on gradually altering the inductance. S. G. S.

581. *Electric Conductivity of Recently Prepared Gas and of Air acted on by Phosphorus.* E. Bloch. (Annal. Chim. Phys. 4. pp. 25-144, Jan., 1905.)—An elaborate experimental study of the above subjects, the chief conclusions drawn from which are as follows: (1) The conductivity of dry air found over phosphorus is susceptible of a regular study and yields definite results. (2) The current which may be passed cannot overstep a certain limit (the current of saturation) dependent on the ions. (3) The mobility of the ions, measured by the method of gaseous currents, is very small and of the same order as that of the other exceptional ions met with in such phenomena. The value of the coefficient of recombination is in accord with that of the mobility. (4) The emanation of phosphorus is able to condense aqueous vapour when simply saturated. The ions contained in it are veritable charged nuclei, and the condensation occurs on them. (5) The conductivity possessed by recently prepared gases is due to ions as in the previous case. [See also Abstracts Nos. 1050 (1908) and 610 (1904).] E. H. B.

582. *Experiments with Radium.* J. Precht. (Deutsch. Phys. Gesell., Verh. 7. 2. pp. 22-24, Jan. 30, 1905.)—The author describes experiments which he considers tend to show that the complexity of the phenomena of the glow and brush discharge can scarcely be explained by the customary hypotheses. Using a spark coil and two balls, 1 cm. and 8 cm. diam. (the latter as kathode), putting a Geissler tube in shunt to the gap and so arranging matters that the discharge takes place more readily through the tube, on bringing some radium near, the tube is darkened and the discharge goes by the spark-gap; at the same time the p.d. (by Braun type electrometer) drops from 2,700 to 1,800. In another experiment, with longer spark-gap, sparks or a positive brush being normally obtained, the discharge, on bringing radium near (even metres away), goes over into the glow discharge with a rise in p.d.; this latter arrangement is so sensitive that it is suggested as supplying a method of measuring the absorption of metals for radium rays. Placing the medium in a magnetic field of intensity 625 units, the previously extinguished spark reappears again. The effect he considers to be due to the β -rays, and the experiment is a simple method of showing their deviability. The α -rays also have this extinguishing property, but only at short distances. The author concludes that one is dealing here with a phenomenon which is practically independent of the ionisation. L. H. W.

583. *Theory of the Photo-electric Current.* E. v. Schweidler. (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 1120-1128, July, 1904. From the physikal.

Inst. der. k.k. Univ. in Wien.)—The relation between current density, i , and potential, E , at distance d from the kathode, which is maintained at zero potential is found in the case of a unipolar conducting gas to be—

$$i = (1/4\pi) \omega u (E^2/d^2),$$

u being the velocity of the ions and ω a quantity which depends upon E , d the sensitiveness to light of the kathode, and the intensity of light falling upon it. The author proposes that ω should be deduced by means of the formula, from measurements of E , i , and d , and he has calculated a series of values of ω for the conditions of his experiment. This quantity has a maximum value (9/8), and hence with given values of E and d there is a maximum value towards which i tends, with increasing illumination of the kathode, and which the author calls the limiting or boundary current ("Grenzstrom"). Also for given intensity of illumination of kathode there is a maximum value towards which i tends as E increases; which value is called the saturation current [see Abstract No. 141 (1900)]. The relation between E , i , and d in the neighbourhood of these limits is discussed. [See also Abstract No. 1958 (1904).] S. G. S.

584. *Tuning of Thermoelectric Receivers for Electric Waves.* A. D. Cole. (Elect. World and Engineer, 45. p. 43, Jan. 7, 1905. Paper read at Philadelphia meeting of the Amer. Assoc. for Advancement of Science.)—Using cylinders with rounded ends instead of spheres, in Righi's form of electric oscillation apparatus, the author has examined the condition for maximum effect of the oscillator on the receiver. The receiver is provided with a thermoelectric junction of fine iron and constantan wire, a galvanometer deflection of 800 scale divisions being in this way easily obtained. The author finds that maximum resonance occurs when the cylinders of the receiver are about 20 per cent. longer than those of the exciter; and further, the wave-length, as obtained by the method of interference, is that of the receiver and not that of the exciter, whether the mirror is placed behind the receiver or the exciter. In the case in which the receiver is tuned to give maximum resonance, the wave-lengths of receiver and exciter are identical. S. G. S.

585. *Rational Construction of Tesla Transformers.* P. Drude. (Ann. d. Physik, 16. 1. pp. 116-183, Jan. 26, 1905.)—A further mathematical contribution on this subject which has been previously dealt with in Abstract No. 950b (1904). The calculation of the dimensions to be given to the coil in order to obtain the greatest terminal p.d. is now first indicated, since it has been shown that the decrement γ in the primary circuit is practically independent of the capacity and self-induction within the limits used [see Abstract No. 186 (1905)]. The paper does not admit of abstraction. It is found that the maximum p.d. is proportional to the cube root of the ratio of C_1/g , where C_1 = primary capacity and g = distance of one turn from the next; the turns should therefore be as near together as the necessary insulation will permit. L. H. W.

586. *Diminution of the Period of Electrical Oscillations which Accompanies a Diminution of Radiation.* W. Lébédinsky. (Journ. de Physique, 4. pp. 22-26, Feb., 1905.)—The author describes some experiments with an oscillator, consisting of a Leyden jar, spark-gap, and a rectangular oscillating

circuit, and a resonator similar to the transmitter, but provided with a sliding bridge and a micrometer spark-gap. It was found that on bringing a metal sheet up behind the oscillator, thus reducing the radiation, the bridge of the resonator had to be moved so as to make the area smaller to produce resonance, the nearer the screen was placed. On the screen being placed near the resonator, the bridge had to be moved in the opposite direction to produce resonance, but the spark at the resonator was in this case always longer than with the screen near the oscillator (in the ratio 17:12), and the resonance was also more marked. The author also tried the effect of radium on the oscillations. He was led by his former experiments [see Abstract No. 1481 (1903)] to the conclusion that radium increases the decrement, and consequently it would be expected to diminish the radiation of the oscillator. This was found to be the case, and, further, that the radium rays produced a diminution in the period of the oscillator; the resonance curve is, however, also made more steep, which is contrary to the author's conclusions as regards the decrement. The explanation that the effect of radium is to both increase the energy of the spark and at the same time reduce the resistance of the spark, is put forward tentatively. The distance between oscillator and resonator was in all cases 50 cm. [There is evidently a misprint in the second table of spark-lengths, 0.9 mm. (?) should be 0.09 mm. (?).] L. H. W.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

587. *Determination of the Electrical Conductivity of Sodium by Means of the Induction Balance.* E. Lohr. (Akad. Wiss. Wien, Sitz. Ber. 118. 2a. pp. 911-923, July, 1904. From the II. physikal. Inst. der k.k. Univ. in Wien.)—The author used Wien's form of the induction balance and Wien's procedure. As the manipulation of sodium in the spherical form was not easily practicable, it was necessary to have the metal in the shape of cylindrical plates. This was attained by pressing lumps of sodium against a flat glass surface, and then cutting out circular discs of the required dimensions. The mean value found for the conductivity at 18.7° C. was 21.5×10^{-9} (with a probable error of 0.069×10^{-9}). For the determination of the temperature coefficient the same discs of sodium were used; covered with vaseline they were warmed up in a glass dish—the dish after being surrounded with flannel was brought into the coil. The method is not altogether suitable for determining the temperature coefficient, as during the observations the copper wire of the coil becomes heated to a sufficient extent to disturb the bridge adjustment. It was sought to obviate this difficulty by making many and rapid determinations. The mean coefficient found for the interval 20°-70°, was 4.886×10^{-3} (with a probable error of 0.04×10^{-3}). This result may be compared with that recently obtained by Bernini, viz., 0.00439 for the interval 0°-97.8°. In the author's opinion Bernini's result (obtained by the capillary method) is too low, as is also that of Matthiessen. The author points out that the Wien method is in general very satisfactory in the case of good conductors which can be easily shaped, and for which it is desirable to have large surfaces exposed, e.g., in investigations of the change of conductivity brought about by radiations. D. H. J.

588. *Mutual Induction of Two Coaxial Circular Coils.* H. Nagaoka. (Mathematical and Physical Soc., Tokyo, 2. 17. pp. 238-266, 1904.)—Follow-

ing the methods of Maxwell, the author has found two rapidly converging series for the value of M , the mutual induction coefficient. By aid of these series, tables have been calculated which not only go finer than Maxwell's (tenth of a degree), but also obviate the necessity of using elliptical integrals. These tables occupy four pages of the present paper, which gives also examples of their use, the results agreeing with Maxwell's. E. H. B.

589. Transmission of Compass Readings on the Siemens and Halske System. (Deutsch. Phys. Gesell., Verh. 7. 2. pp. 9-10, Jan. 80, 1905.)—A brief description is given of this system, devised by Einthoven, which enables the position of the main compass card to be read off on a receiving instrument, suitably placed, at any distance. The compass (Kaiser system with four peripheral magnets) has on its card a mica window embracing an angle of 90° , the window being placed between a glow lamp and a grating system made up of 200 radial platinum strips, which both form part of the compass casing. The grating is in four parts, each embracing 90° , each pair forming opposite arms of a Wheatstone's bridge. On the ship turning, the relative movement of the mica window and the lamp and grating system alters the position of the beam falling upon the platinum strips. The currents from the bridge are led to two coils placed at right angles to one another in a strong magnetic field. The receiving compass card being fixed to the movable coils, it follows the movement of the compass in a continuous manner, without jumps. The instrument was exhibited at the meeting. L. H. W.

590. Photographic Registration of Galvanometer Deflections. H. Diesselhorst. (Deutsch. Phys. Gesell., Verh. 7. 2. pp. 32-33, Jan. 80, 1905. Communication from the Physikalisch-Technische Reichsanstalt.)—In the ordinary method of registering photographically the successive values of a varying galvanometer deflection, a photographic plate is moved perpendicularly to the direction of deflection at a known velocity. In order to obviate the complication involved in moving the plate, the author uses a fixed plate, upon which the galvanometer-mirror casts the image of a glow-lamp filament. The circuit of the lamp is completed by a relay actuated at definite intervals by means of a contact-making pendulum. The course of the deflection is thus marked out by a series of streaks (images of the filament) formed at equal intervals of time. By a simple mechanism operated by the relay each fifth and tenth streak may be partially screened off so as to render them distinguishable. The glow-lamp should be run at a voltage considerably above the normal, so that its illumination occupies only a small fraction of a second.

J. D. C.

ALTERNATING CURRENTS AND MAGNETISM.

591. Resistance of Coils to Alternating Currents. A. Sommerfeld. (Ann. d. Physik, 15. 4. pp. 678-708, Dec. 6, 1904.)—This is a mathematical paper treating of the alternating field and resistance to alternating currents of coils of one or more layers. The increase of resistance under these conditions was observed by F. Dolezalek, and theoretically explained by M. Wien [see Abstracts Nos. 488B and 2272 (1904)]. The present paper deals with the whole subject very fully, following Maxwell's methods. Formulæ are obtained for the resistance which, with the corresponding change of the

variables, reduce to Rayleigh's expression for a straight wire. Curves and diagrams are given illustrating the concentration of the current to *one side of the wire*. E. H. B.

592. *Hall Effect in Electrolytes*. R. Heilbrun. (Ann. d. Physik, 16. 5. pp. 988-1002, Dec. 28, 1904.)—The author reviews the present state of the discussion as to the existence of a true Hall effect in electrolytes [see Abstracts Nos. 46 and 945 (1898), 878 (1902), and 154 (1904)]; he also describes several experiments whose object is to solve this question. In the first experiment copper electrodes in a solution of copper sulphate are used. The kathode is in three parts, one above the other, and arranged in such a way that the Hall effect due to a transverse magnetic field would increase the rate of deposit of copper on one plate and decrease it on the other. The deposits on the three plates are determined by weighing after successive equal intervals of time, first without magnetic field and then with it. The results are of a negative character. In the next experiment the author attempts to plot the equipotential lines in a shallow vessel containing a solution of copper sulphate, through which a current is flowing; the moving terminal is a copper wire. With this arrangement no definite lines of equipotential could be found, so the author replaced the copper wire by a liquid contact, and used a suspended "coil," electrolyte galvanometer, in which use is made of the fact that an electrolyte carrying a current produces the same magnetic effect as a metallic conductor carrying the same current [see Abstract No. 305 (1899)]. The instrument is described in considerable detail. It is found that the equipotential lines undergo redistribution in a magnetic field; also the effect varies with time. The paper ends with a reference to the experiments of Drude and Nernst on gelatinised electrolytes, in which it was found that the act of gelatinising the electrolyte caused the supposed Hall effect to vanish. It is therefore concluded that there is no true Hall effect in electrolytes, but that the redistribution of equipotential lines found by Bagard, Roiti, and the author are secondary effects due to the rotation produced in the liquid by the magnetic field.

S. G. S.

593. *Systems of Magnetic Forces Causing the Secular Variation of the Uniform Portion of the Earth's Magnetism*. L. A. Bauer. (Terrestrial Magnetism, 9. pp. 173-186, Dec., 1904. Paper read before the National Academy of Sciences, New York, Nov. 15, 1904.)—Assisted by J. A. Fleming, the author has analysed the variation during the period 1843-85, making use of the coefficients of Adams, Fritsche, and Schmidt, and confining himself to the portion which may be regarded as equivalent to a uniform magnetisation about a diameter inclined approximately 11° to the axis of rotation. This portion appears to be subject to a secular variation arising from systems of magnetic or electric forces, two of which are as follows: (a) A magnetic system situated below the earth's surface whose axis is directed about opposite to that of the primary internal field, and is displaced in longitude at present about 68° to the west. Chiefly as result of this demagnetising system, the earth's magnetic moment is at present being diminished by about $1/2400$ part annually. (b) A magnetic system situated above the earth's surface whose axis is directed almost transverse to the axis of rotation, and is displaced in longitude at present about 151° to the west of that of the primary internal field, and about 83° to the west of that of the internal secular variation system. This system plays an important part in the variation of the declination. There are changes both in the direction and in the intensity of the magnetisation. The author has,

therefore, modified the views expressed in 1899 and 1903 that the main cause of the secular variation was due to a system of forces imbedded in the earth, and not to an external system. It will be necessary to take into account effects from potential systems to terms of the sixth order, and there are indications that regional or local conditions can have an overpowering effect on the secular variation. H. B.

REFERENCES.

594. *On Unipolar Induction and the Fundamental Electromagnetic Equations.* J. A. Vollgraff. (Archives Néerlandaises, 9. pp. 340-380a, 1904.)—A discussion (chiefly mathematical) of the above subjects, some parts of which are, however, withdrawn as unsound by the author himself, in a note under a later date appended to the paper. H. A. Lorentz (Ibid. pp. 380b-380d). Lorentz criticises Vollgraff's paper. E. H. B.
595. *Electrodynamics of Moving Systems.* II. E. Cohn. (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 53. pp. 1404-1416, Dec. 15, 1904.)—The second part of a highly analytical treatment of the electrodynamics of moving systems on the basis of Maxwell's theory. [See Abstract No. 188 (1905).] E. H. B.
596. *Equilibrium of a Fluid in a Magnetic Field.* S. Sano. (Mathematical and Physical Soc., Tokyo, 2. 17. pp. 248-263, 1904.)—This paper deals with the equilibrium and isothermal and adiabatic changes of a fluid consisting of only one independent constituent and in one phase when placed in a magnetic field. It is too mathematical to admit of abstraction with advantage. It follows the work on electro- and magneto-striction of Koláček and others. [See also Abstracts Nos. 332 (1904) and 190 (1905).] E. H. B.
597. *Magnetic Field Produced by Motion in an Electric Field.* H. Pellat. (Comptes Rendus, 140. pp. 229-231, Jan. 23, 1905.)—A demonstration of the theorem that the magnetic field in question is represented by K -times the vector product of the velocity and the electric field, K being the permittivity. [See Abstracts Nos. 2269 and 2270 (1904).] E. H. B.
598. *Ratio between Electrical and Gravitational Forces.* B. Davis. (Elect. World and Engineer, 45. pp. 43-44, Jan. 7, 1905. Paper read at Philadelphia Meeting of the Amer. Assoc. for Advancement of Science.)—By making certain assumptions as to the relation of charge to mass in the atom, and using the most probable value of the ratio of charge to mass for the negative electron, the author finds that the ratio of the electrical force between all the electricity of one kind associated with a given mass to the gravitational force, is a number which is equal to the fourth power of the velocity of light expressed in cm. per sec. S. G. S.
599. *Dispersion of Atmospheric Electricity on Tenerife.* W. Knoche. (Phys. Zeitschr. 6. pp. 2-4, Jan. 1, 1905.)—The author made some observations with an Elster-Geitel electroscope on Tenerife in Sept., 1904, on the Pico de Teyde, at an altitude of 3,252 m., and on the shore at Puerto Orotava. On the volcano quite abnormal values of $a-$ and q (in a few cases also of $a+$) were obtained, q going up to 17. This may be due to some radio-active emanation from the solfataras, which frequently caused sudden discharge of the electroscope, and which may also be responsible for the mountain sickness. [See A. Loewy and F. Müller, Abstract No. 2269 (1904).] H. B.

600. Electronic Theory of Magnetism. P. Langevin. (Comptes Rendus, 139, pp. 1204-1207, Dec. 26, 1904.)—The author thinks it possible to explain para- and dia-magnetism by means of electrons. As the results are to be given more fully later, abstraction of them is reserved until then. R. S. W.

601. Electric Radiography. V. Gabritschewski. (Phys. Zeitschr. 6, pp. 33-34, Jan. 15, 1905.)—The author gives in this paper several reproductions of the figures produced when after a piece of radium and several preferably flat articles are laid upon a sheet of ebonite for 10-15 min., the surface of the ebonite is dusted with a mixture of powdered sulphur and litharge, as used to produce Lichtenberg's figures. A radiograph of the hand taken in this manner, with a thin sheet of ebonite between the radium and the hand, gave a picture on both sides, the pictures themselves being neutral and the surrounding field positive (yellow), but on the radium side the picture is bordered at one side by a red and at the other a yellow edge. The distortion of the apparent shapes is commented upon; a probable explanation of the cause is given. L. H. W.

602. Ions in the Atmosphere. P. Langevin. (Comptes Rendus, 140, pp. 232-234, Jan. 23, 1905.)—Recognising the importance to meteorology of the study of atmospheric ions, experiments have been undertaken since May, 1904, on the summit of the Eiffel Tower. The author finds there ions of two degrees of mobility. The first are ordinary ions of mobility about $k = 1.5$ cm. for 1 volt per cm. The others are of mobility represented by $k = 1/3000$ nearly. These are of the same order as those observed by Townsend in recently prepared gases, and by Bloch for ions due to phosphorus. E. H. B.

603. Alternating Discharges. W. Lessing. (Deutsch. Phys. Gesell., Verh. 6, 22, pp. 340-342, Nov. 30, 1904. Physikal. Inst. der Univ., Erlangen.)—The author gives a short abstract of his 1902 Dissertation, a phenomenon described in it by him having been independently described by Gehrcke [see Abstract No. 2265 (1904)]. The alternating currents for the vacuum tube are produced by an induction coil, the primary of which is fed with a sine current, a rotating double-contact apparatus, coupled to the axle of the continuous-current transformer employed, allowing the determination of the distribution of current and e.m.f. in the vacuum tube. Discharges of low alternation frequency show that the phenomena of alternating currents agree with those of continuous currents, although sometimes the effect is obscured by that of the previous half-period. G. E. A.

604. Cause of Ionisation of Air by Phosphorus. E. Meyer and E. Müller. (Deutsch. Phys. Gesell., Verh. 6, 22, pp. 332-336, Nov. 30, 1904. Physikal. Inst. der Univ., Berlin.)—The authors describe experiments which confirm the conclusions obtained by other investigators [see Abstracts Nos. 1122, 2260, and 3276 (1904)] that oxidation, emission of light, and conductivity of air disappear at the same time. The conductivity is not due to waves of short wave-length given off on the oxidation of phosphorus—no ultra-violet rays could be detected. Nor does the conductivity appear to be caused by the deoxygenation of the ozone. A. F.

605. Kathode Rays and Magneto-friction. P. Villard. (Comptes Rendus, 139, pp. 1200-1202, Dec. 26, 1904.)—The author comes to the conclusion that the phenomena treated by Pellat as due to magneto-friction can be quite readily explained by the usual laws of electromagnetism. R. S. W.

606. Ionisation in Flames. P. Massoulier. (Comptes Rendus, 140, pp. 234-236, Jan. 23, 1905.)—A résumé of work on this subject, followed by a short account of the author's own experiments and views on the matter. [See also Abstracts Nos. 1108 (1901), 1412 (1903), and 2297 (1904).] E. H. B.

607. New Photo-electric Experiment. F. R. Gorton. (Deutsch. Phys. Gesell., Verh. 7. 2. p. 42, Jan. 30, 1905.)—The author finds that a metallic point can be made sensitive to light, so that after the p.d. is lowered to a value at which the current ceases (minimum p.d.), the radiation from an arc lamp starts the current again. The radiation lowers the minimum p.d., in the case of the experiment, with a platinum point previously heated to redness, in oxygen, about 1,000 volts. The manipulation by which the point is made sensitive always produces an elevation of the minimum p.d., the radiation apparently bringing it back to the original value. Further results are to be communicated. L. H. W.

608. Rectification of the Current in Crookes Tubes by Villard's Process. G. Gaiffe. (Archives d'El. Médicale, 13, pp. 118-116, Feb. 10, 1905.)—The author shows that whereas at present generally three vacuum valves are used to rectify the high-frequency currents used for supplying Röntgen-ray tubes without an interrupter, of which one valve is placed in series with the tube to stop the inverse wave, a perfect rectification can be obtained with only two valves if these are placed in shunt to the Röntgen-ray tube. Several experiments are described to show that the one wave discharges through the tube, and the other, inverse one, through the valves, and that the p.d. at the tube terminals during the inverse wave is only about equal to 1 mm. spark length—not sufficient to cause oscillations. L. H. W.

609. Disjuncor for High Potential. F. W. Adler. (Ann. d. Physik, 15. 5. pp. 1033-1042, Dec. 23, 1904. Phys. Inst. d. Univ., Zürich, Oct., 1904.)—In order to obtain a unidirectional current by means of an induction coil, a key similar to a Pohl's commutator is placed in the secondary circuit and reversed between each make and break of the primary. Thus the currents in opposite directions in the coil are commutated so as to flow in one direction in the external circuit. The disjuncor consists of the commutator and interrupter, actuated by a system of levers moved by electromagnets; the circuits are so arranged that the cycle proceeds automatically in the required order. Many sketches, and a very full description are given. S. G. S.

610. Hertzian Wave Detector. J. Rodet. (Electricien, 29. pp. 69-70, Feb. 4, 1905.)—The author describes a form of coherer in which of a number of steel balls in a glass tube every alternate one is oxidised; pressure is applied and regulated by a screw at one end. It is said to be perfectly auto-decohering. L. H. W.

611. Thermoelectric Properties of Aluminium Alloys. H. Pécheux. (Comptes Rendus, 189. pp. 1202-1204, Dec. 26, 1904.)—Numbers are given showing the e.m.f.'s for binary alloys of aluminium with tin, lead, bismuth, magnesium, antimony, and zinc in different proportions. No general conclusions are drawn. R. S. W.

612. Influence of Torsion in Suspended Magnets. F. Bidingmaier. (Terrestrial Magnetism, 9. pp. 157-162, Dec., 1904.)—The author demonstrates that, contrary to the opinions of Lamont, Maxwell, and Mascart, torsion does exert an influence when deflections are determined by the sine, and even by the tangent methods. The effect will be comparatively great with weak deflection magnets and near the poles, and when careful detorsion is impossible on expeditions. Formulee for the corrections are deduced. H. B.

613. Specific Magnetic Susceptibility of Liquids. G. Meslin. (Comptes Rendus, 140. pp. 237-239, Jan. 23, 1905.)—The above constant is determined for about 30 diamagnetic organic liquids, the results of Plücker, Faraday, Becquerel, Quincke, and Henrichsen being also quoted. It is considered that the disparity in the results of different observers is caused through employing different values for the density of the liquid when reducing values of the specific susceptibility to susceptibility as ordinarily defined. G. E. A.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

614. *New Electric Furnace.* H. N. Morse and J. C. W. Frazer. (Amer. Chem., Journ. 82, pp. 98-119, Aug., 1904.)—The authors describe in detail a new form of electric furnace, devised to overcome the difficulty of regulating the temperature during the preparation of osmotic cells. The furnace is calibrated by determining its resistance for all temperatures up to the maximum desired. An accurately calibrated electric furnace is very suitable for the study of reactions at high temperatures, but for the attainment of accurate results it is necessary to reduce to a minimum the period of time required for the establishment of equilibrium between the temperature of the furnace and that of the outside air. This is best done by coating the furnace with graphite, the electrical conductivity of which increases as the temperature rises. The main portion of the current passes through the furnace, the remainder flowing over the graphite surface in contact with the air, and so bringing about an automatic compensation for the increased loss of heat to the external air which attends any rise in the temperature of the furnace. For details reference must be made to the original. T. H. P.

615. *Materials for Resistors.* F. A. J. FitzGerald. (Electrochem. Ind., N.Y. 2, pp. 490-495, Dec., 1904.)—The word "resistor" is employed to connote a substance used because of its property of offering resistance to the passage of an electric current, whilst the word resistance is reserved for the quality either in a qualitative or quantitative sense. For furnace work the most elementary form of resistance furnace is one in which the charge itself forms the resistor, such as in Gin's steel furnace or in the Acheson graphite furnace. The former is simple in theory, for the total change of temperature in the resistor only amounts to 600° C. (from 1,800° to 1,900°), and this does not produce any notable change in the specific resistance of the molten metal. The conditions are more complex in the graphite furnace, inasmuch as the resistor is a mass of cold carbon which is raised to the highest attainable temperature, and there is hence produced a great resistance change. In addition, a further diminution of resistance is caused by the conversion of the amorphous carbon into graphite. It is shown that it is better to use graphite for a resistor, so that the only change is that due to an increase in temperature. Next, the variety of substance that should be converted into graphite is considered. This has been dealt with in the author's "Monographien über angewandte Elektrochemie, xv. Band. Künstlicher Graphit," where it has been shown that even when carbon is raised to the graphitising temperature its properties will depend largely on the kind of amorphous carbon used, and that by choosing different kinds of carbon we may get variations in resistivity which are useful in the construction of resistors. As an extreme example, the specific resistance of petroleum coke and retort carbon will be very different even after heating both of them to the temperature of the graphitising furnace. A solid carbon rod is not a good resistor, particularly on a large scale, for the reason that to produce a high temperature large currents at small voltages are necessary. On breaking the carbon into many small pieces the resistance will be greatly increased, but will be lessened on increasing the pressure. The general characteristics of granular carbon are discussed. An experiment with granular coke is described which was found to lessen in resistance as it was electrically

heated up to a certain point, when it commenced to increase in resistance. This is attributed to the formation of carbides at the contact points. The coarser the granules the lower the resistivity, and it is important not to pack the carbon too tightly. This does not apply to the region of the electrodes, where good contact is desirable, and around which the carbon should be tightly rammed. Graphite powder is much superior to amorphous carbon for this latter purpose, and probably the best material of all is found in the beautiful soft graphite obtained by the decomposition of silicon carbide. Generally it is advised to have the granules of a uniform size. If a mixture is required of greater resistivity than can be obtained with carbon, a silico-carbide or silicon carbide is the most likely to produce satisfactory results.

W. W. H. G.

616. *Volatilisation of Solids at Ordinary Temperatures.* C. Zenghells. (Zeitschr. Phys. Chem. 50, pp. 219-224, Dec. 16, 1904. Chem. Laborat. der techn. Hochschule, Athen.)—This volatilisation was studied by two methods. In the first method strips of silver leaf were hung up in a desiccator above a layer of the substance to be tested. It was found in the case of many oxides, e.g., CuO, ZnO, PbO, PbO₂, Fe₂O₃, MnO₂, CoO, As₂O₃, Sb₂O₃, CrO₃, &c., that the presence of the corresponding metal could be analytically detected in the silver after some time (one or two weeks to six months). Simultaneously the surface of the silver nearest the layer of oxide acquired a reddish or golden colour. The action proceeds much more rapidly in the presence of aqueous vapour. Other substances besides oxides were investigated, e.g., S, Se, Pb, Cu, P (red), SnS₂, As₂S₃, Sb₂S₃, Cu-carbonate, Zn-chloride, Pb-iodide. In all these cases distinct, and in some cases very pronounced, evidence of volatilisation was obtained. In the second method, instead of strips of silver-leaf, some reactive liquid was employed. Thus a 10 per cent. solution of K₂Fe(CN)₆ placed in the neighbourhood of Cu or CuO (in a closed vessel), became reddish-brown after three weeks. In conclusion, the author discusses the bearing of these results on the emanation of radium, the emission of negative electrons by glowing oxides and other allied phenomena.

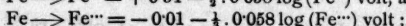
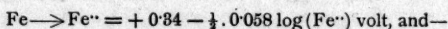
F. G. D.

617. *Preparation of Barium.* Guntz. (Annal. Chim. Phys. 4, pp. 5-25, Jan., 1905.)—Reviewing the literature on the subject, the author maintains that pure barium has not been prepared yet. He obtained a metal with 98.35 per cent. of Ba, 0.8 of Hg, and 0.4 of iron from electrolytic barium amalgam of 8 per cent., first enriched by ordinary distillation to 10 per cent. of Ba, and then very slowly distilled with the aid of a resistance coil. Barium is described as a metal of tin colour, as soft as lead, melting at 850° and boiling at 1,150°; it dissolves in absolute alcohol, not in benzene, attacks metals (iron least) and most gases, and combines readily with hydrogen and nitrogen at higher temperatures; the distillation of the amalgam has hence to be effected in a vacuum. The BaH₂ resembles the hydrides of Li and Ca; it is very stable at high temperatures, and volatilises slowly at 1,400° in a hydrogen atmosphere; it is decomposed by water and damp air, and yields, heated with nitrogen, Ba₃N₂. The formation of barium hydrate from the metal and water liberates 92.5 cal. Fused BaCl₂ is reduced by Ba under formation of BaCl; when sodium acts on the fused chloride, the double subchloride NaCl.BaCl is produced, and BaBr, BaI, and BaF₂ yield analogous compounds. Owing to the production of these subhaloids, the electrolysis of barium haloids fails.

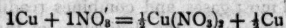
H. B.

618. *Interaction of Hydrochloric Acid and Potassium Permanganate in Presence of Ferric Chloride.* J. Brown. (Amer. Journ. Sci. 19. pp. 81-88, Jan., 1905. Contribution from the Kent Chemical Laboratory of Yale University. Zeitschr. Anorg. Chem. 44. 2. pp. 145-153, March 4, 1905.)—It is known that, in the titration of ferrous salts with permanganate in presence of chlorides, part of the permanganate is used in oxidising the Cl^- -ions, whilst in the titration of oxalic acid this is not the case. Wagner has explained this phenomenon by the assumed formation of chlor-ferrous acid, which is more easily oxidised by the permanganate than is hydrochloric acid under the same conditions. Recent work has, however, shown that there is a slight but appreciable loss of permanganate in titrations of oxalic acid under the conditions named, and that this loss is proportional to the amount of hydrochloric acid present. This is verified by the author's experiments at 50° , which show that the excess of permanganate used is less than in presence of ferrous salts. If a rapid current of carbon dioxide or air is passed through the solution containing ferric chloride and oxalic acid, so as to remove the chlorine as it is formed, the amount of permanganate used increases very largely. There is, therefore, no ground for Wagner's assumption of a catalytic action of the iron salt on the oxidation of the Cl^- -ions. This author's results afford simply an indication of the greater or less retention of chlorine in solution, and of the greater or less oxidising action of this chlorine on the oxalic acid in the presence or absence of ferric chloride. T. H. P.

619. *Theory of Valency.* R. Abegg. (Zeitschr. Anorg. Chem. 48. 1. pp. 116-121, Jan. 16, 1905.)—In a previous paper [see Abstract No. 3021 (1904)] the author has spoken of the electro-affinity or affinity of an element, without considering the variation of this in the case of ions capable of possessing different valencies. It may be asked how the affinity will be exerted when Fe is treated with 2Cl : whether only FeCl_2 will be formed, or a mixture of FeCl_2 and FeCl_3 . The latter would be theoretically expected, and this agrees with experiment, as is seen when the quantitative relations are considered with reference to the differences of affinity:—



when there is equilibrium, $\frac{2}{\text{Fe}^{++}} = 10^{-6} \sqrt{\text{Fe}^{+++}}$. Taking the concentration of the ferrous salt as 1, that of the ferric salt will be about 10^{-18} , which is not detectable analytically, and therefore not contradictory to experiment. From the above it follows that the valencies become increasingly different as the degree of saturation diminishes, and this holds also in cases where, as with copper, the higher degree of valency has a greater tendency to form at ordinary concentrations. In the same way reactions like—



must be regarded as dependent on the concentration. The author adduces confirmations by other authors of his views on the amphoteric-polar nature of valencies, and argues for the general validity of the assumption that an element has a more basic function the higher its valency. T. H. P.

620. *Conductivity of Unsaturated Acids.* F. Fichter and A. Pfister. (Liebig's Ann. d. Chemie, 384. pp. 201-210, April 10, 1904. Chem. Universitätslaborat. Basel.)—The number previously given by the authors (Ber. Deut. Chem. Gesell. 35. p. 988, 1902) for the dissociation-constant of vinylacetic

acid is found to be erroneous, fresh measurements giving the mean value of K as 0.00888. This value is nearly twice that found by Ostwald for crotonic acid ($K = 0.00204$), and this is the first observed case of two unsaturated acids differing only in the position of the double linking, in which the $\beta\gamma$ -unsaturated acid has a higher degree of dissociation than the $\alpha\beta$ -acid. That this is always the case is shown by a series of further measurements on unsaturated acids. This rule is obeyed both by aliphatic and cyclic acids, and is concerned only with the position of the double linking relatively to the carboxyl group. Where the double bond is in the $\gamma\delta$ - or $\delta\epsilon$ -position, it appears, from the results obtained up to the present, that there is a regular decrease of the dissociation coefficient. The numbers arrived at are given in the following table:—

Butyric acid.....	0.00154	Valeric acid.....	0.00161
Crotonic acid	0.00204	$\alpha\beta$ -Pentenoic acid	0.00148
Vinylacetic acid	0.00888	$\beta\gamma$ -Pentenoic acid	0.00385
		$\gamma\delta$ -Pentenoic acid	0.00209
α -Methyl- $\alpha\beta$ -pentenoic acid	0.00097	Hexoic acid	0.00146
α -Methyl- $\beta\gamma$ -pentenoic acid	0.00299	$\alpha\beta$ -Hexenoic acid	0.00189
α -Methyl- $\gamma\delta$ -pentenoic acid	0.00216	$\beta\gamma$ -Hexenoic acid	0.00284
		$\gamma\delta$ -Hexenoic acid	0.00174
		$\delta\epsilon$ -Hexenoic acid	0.00191

These numbers show that the $\alpha\beta$ -unsaturated acids are feeblar acids than would be expected from the negative character of the double linking and the greater influence of the α -substituents on the affinity constants of acids. An explanation for these abnormal results is given by Thiele's theory of partial valencies, according to which the $\alpha\beta$ -unsaturated acids contain a conjugated system of double linkings, so that the system is less unsaturated than in the case of the $\beta\gamma$ - or $\gamma\delta$ -unsaturated acids. T. H. P.

621. *Molecular Volume of Solids and Relation of Osmotic Pressure to Freezing-point Depression and Boiling-point Elevation of Solutions.* W. VAUBEL. (Journ. für prakt. Chem. 2. 69. pp. 545-559, June 28, 1904.)—The author criticises the methods of J. Traube and of Longinescu for determining the molecular weights of solid compounds. He further shows that the lowering of vapour pressure is the same for all solvents if the number of dissolved molecules bears a constant ratio to the number of molecules of the solvent. The same holds for the elevation of boiling-point if 1 gm.-mol. of the solute is dissolved in 1 gm.-mol. of the solvent; the molecular boiling-point elevation $\times 100$: molecular weight = 3.15, the minimum and maximum values found for the solvents examined being 2.6 and 4.2 respectively. This must also hold for the freezing-point depression when the true value for the molecular weight is taken. The smallest number found for this ratio is 17.2, given by palmitic acid, which is non-associated. On dividing the higher values obtained for other compounds by 17.2 the association factors are arrived at; in this way, water gives the association factor 6, which is in agreement with values previously obtained and with the hexagonal formation of ice crystals, while benzene gives the factor 4, in accord with its rhombic crystalline form. The loss of energy suffered by a solvent in the neighbourhood of its freezing-point or in that of its boiling-point, by the solution of 1 gm.-mol. of solute per gm.-mol. of solvent, is therefore equally great for all solvents; at the freezing-point it is 5.5 times as great as at the boiling-point. Hence the osmotic pressure must really diminish as the temperature rises. The

increase of the osmotic pressure corresponds with the expansion of the vaporous molecule. When a substance is dissolved in water its molecule enters into reaction with the complex $(H_2O)_n$, forming $(H_2O)_nM$ and setting free $1H_2O$. This liberated water molecule functions as a gas molecule and produces the apparent rise in the osmotic pressure, which approximates to the pressure equivalent to the rise in the boiling-point. The freezing-point depression of a solution is due to the dissolved molecule as well as to the water molecule, whilst the raising of the boiling-point is due to the latter alone. The energy rendered latent by solution of a substance near the freezing-point of the solvent is equivalent to a pressure of 227.6 atmospheres, and that at the boiling-point to 68 atmospheres. T. H. P.

622. *The Possible Resolution of Racemic Compounds by Circularly Polarised Light; the Primary Production of Optically Active Material.* A. Byk. (Zeitschr. Phys. Chem. 49. pp. 641-687, Dec. 6, 1904. From the Photochem. Laborat. der techn. Hochschule, Berlin.)—The author seeks to prove by an indirect but, nevertheless, experimental way, that it is possible to resolve racemic compounds by a purely physical means, viz., the action of circularly polarised light; he then shows that we have on the earth's surface natural conditions which lead to the formation of an excess of one kind of primary active material out of inactive material—without the intervention of previously existing active bodies or living organisms. As a starting-point for the indirect experimental proof mentioned above, the author utilises an experiment of Cotton's, who showed that the *d*- and *l*- of copper-alkali tartrates (Fehling solution) possess different coefficients of optical absorption for circularly polarised light of definite sign. With the help of the photochemical law of absorption (the experimentally proved principle of the coincidence of the maxima of optical absorption and photochemical sensitiveness), it may thence be inferred that the amounts of decomposition in circularly polarised light must be different for these optically sensitive compounds. Further, with the aid of the Ostwald principle of the independent optical absorption of the ions in different solutions, the conclusion may be drawn that the varying sensitiveness must still persist in the inactive Fehling solution, and must, therefore, lead to a gradual development of optical activity owing to the photochemical decomposing action of the circularly polarised light. The above argument necessitated experiments (1) to justify the extension of the photochemical law of absorption to circularly polarised light in general; (2) to prove the validity of the application of the law of absorption to Fehling solutions; (3) to show the existence of the separate single tartrates in Fehling solution. To extend the physico-chemical phenomena to biology it is necessary to believe that an excess of some kind of circularly polarised light is to be found on the surface of the earth. This is indeed the case. Circularly polarised light is formed, according to Jamin, by reflection of the linearly polarised part of the light of the sky at the surface of the sea. The rotation of the plane of polarisation of the light by the earth's magnetism is such that neither at any particular point of the earth's surface, nor over the surface as a whole, nor over long intervals of time, is there an equal production of the two forms of circularly polarised light. Hence we have, in fact, a steady source of one-sided asymmetry, operative in the biological, photochemical process of plant growth. The author obtained certain secondary results during the main work: (1) A comparison was made of the sensitiveness of optically active photographic preparations (silver tartrate paper and silver bromide plates sensitised by

chlorophyll) to *d*- and *l*-circularly polarised light; no difference was found in the action of *d*- and *l*-light; (2) Fehling's solution was found to give a very emphatic illustration of the law of photochemical absorption; (3) the production of the racemic salt by mixing *d*- and *l*-Fehling solutions is accompanied by a change of colour. The progressive dissociation of a racemic Fehling solution, on gradually diluting the solution, was studied in some detail.

D. H. J.

623. *Hydration of Lactose in Solution.* C. S. Hudson. (Amer. Chem. Soc., Journ. 26, pp. 1065-1082, Sept., 1904. Research Lab. of Phys. Chem., Massachusetts Inst. of Technology. Zeitschr. Phys. Chem. 50, pp. 278-290, Dec. 20, 1904.)—It has been previously shown by the author [see Abstract No. 1640 (1904)] that the multirotation of freshly-prepared lactose solutions is due to the fact that equilibrium is gradually established between the hydrate of lactose and the anhydrous sugar, according to the equation: $C_{12}H_{22}O_{11} \rightleftharpoons C_{12}H_{22}O_{11} + H_2O$. The substance represented by the left-hand side of this equation is ordinary commercial milk-sugar, which can be readily obtained by crystallisation from water at the ordinary temperature. When the solution is allowed to crystallise slowly at 95-100°, anhydrous lactose, $C_{12}H_{22}O_{11}$, is deposited in large crystals, so that between the ordinary temperature and 95-100° a transition temperature occurs. Measurements of the rotatory powers of the freshly-prepared solution of the hydrate and of the solution of the anhydride at 0° show that in every case the transformation can be represented by the logarithmic formula of the reaction of the first order and that the constant of the formula is the same in the two cases. If a large excess of the hydrate is shaken with water for a few minutes, a solution is formed having a concentration—the "initial solubility"—independent of the quantity of solid taken. With the gradual dehydration which goes on, the concentration slowly increases to a "final solubility," at which the solution contains that quantity of the anhydrous sugar which is in equilibrium with the constant amount of the hydrate which corresponds with the initial solubility and which the solution always contains. When a substance exhibits a rate of solution—the maximum rate of solution—independent of contact between the solid and liquid phases and also an initial and a final solubility, it is possible to arrive at the velocity and equilibrium of the chemical change occurring in the solution even in cases where the substances concerned cannot be estimated separately by any chemical or physical method. Measurements of the maximum solubility at 0°, 15°, and 25° give results in accord with the law of mass action. For the two intervals of temperature 0°-15° and 15°-25°, the changes in the amount of hydration are accurately expressed by the formula $d(\log k)/dT = A/T^2$. The rate of solution is greatly accelerated by the presence of bases. The velocity constants for the precipitation of hydrated lactose from a solution which is saturated as regards the hydrate but contains more of the anhydrous sugar than corresponds with the condition of equilibrium, agree well with the values derived from the solubility determinations. The equilibrium ratio of anhydrous to hydrated lactose, calculated from the initial and final solubilities of the hydrate, is found to be 1.35 at 0°, 1.44 at 15°, and 1.51 at 25°, the degree of hydration thus decreasing considerably as the temperature rises. The amount of lactose undergoing hydration and dehydration in one hour in a solution which has reached a state of equilibrium is calculated from the velocity constant to be at 0°, 1.5 per cent., and at 25°, 22.2 per cent. of the total quantity present. The method of studying the equilibrium of dissolved

substances by the principle of the maximum rate of solution, which is applicable to any reaction proceeding slowly in solution, is made use of in examining the rates of solution of barium nitrate, potassium sulphate, sodium chloride, and iodine in water at 0°, of iodine in alcohol and in ether at 0°, and of arsenious oxide in water at 22°; no evidence is, however, obtainable that any slow chemical change occurs during the solution of these substances. The low rate of solution of arsenious oxide in water is due to a film of air adhering to the surface of the oxide.

T. H. P.

624. Colloidal Ferric Hydroxide. A. V. Dumiansky. (Journ. Russk. Fizik. Khimičesk. Obsčestva, 86. pp. 1067-1069, 1904.)—The colloidal ferric hydroxide examined was prepared by saturating a solution of ferric chloride with ammonium carbonate and purifying the solution obtained by dialysis. The liquids thus prepared contain as much as 5.8 gm. of ferric oxide per litre, but no iron ions are present; the solution also contains chlorine, probably in combination with ammonia. On electrolysis, or with electrolytes such as barium hydroxide, potassium thiocyanate, hydrochloric acid, zinc sulphate, &c., the solution is coagulated, but with mercuric or mercurous nitrate or ferric chloride it forms first a complex colloid; besides this, salts of mercury or copper convert a part of the iron into salts of their acids. By ammoniacal solution of copper oxide, the colloid is precipitated together with cupric oxide, whilst in the presence of organic hydroxy-acids, and on heating, the cupric oxide is reduced to cuprous oxide; the same occurs with ammoniacal silver oxide solution. When the solution is boiled with Fehling's solution, the colloid is precipitated together with cuprous oxide.

T. H. P.

625. Migration of Colloids. W. R. Whitney and J. C. Blake. (Amer. Chem. Soc., Journ. 26. pp. 1339-1387, Oct., 1904. Research Lab. of Phys. Chem. of the Massachusetts Inst. of Technology.)—Colloidal gold solutions, after prolonged dialysis into conductivity water, possess a constant conductivity, which is 5-8 times that of the water outside. On passing a current through the solution placed in a vertical tube closed at the ends by goldbeaters' skin with which the electrodes are in contact, the gold migrates to the bottom, a colourless liquid being formed at the top. The rate of migration can be determined from the movements of the well-defined boundary between the upper colourless liquid and the gold solution. When the gold is repeatedly migrated downwards on to the membrane of goldbeaters' skin and then redissolved in water, the conductivity of the solution almost completely disappears, and is hence attributed by the authors to the presence of electrolytes associated with or adsorbed by the gold. Determinations of the migration velocity for gold, platinum, silver, Prussian blue, ferric hydroxide, silicic acid, and gelatin, show that this velocity is determined primarily by the potential gradient, to which it is directly proportional. If the sludge obtained by the downward migration of colloidal gold solution is placed under pure water, it diffuses upwards into the latter with a velocity comparable with that with which electrolytes diffuse from concentrated solutions into pure water. In certain cases, the downward motion of the above-mentioned boundary line of the colloidal gold solution becomes suddenly retarded or even reversed in direction. This is best seen when the migration takes place in a horizontal tube; it is then found that the reverse motion is not regular, the colloid being repeatedly carried backwards and forwards between the poles. The migration velocity, when not influenced by gravity,

diffusion, or the reverse action, is, for colloidal gold, platinum, silver, Prussian blue, ferric hydroxide, and silicic acid, approximately the same as that of a monovalent ion of a neutral inorganic salt. These facts are in agreement with the investigations of Lamb and Smoluchowski, according to which the velocity of migration of solid particles suspended in water is independent of their size and shape and should be of the same order of magnitude as the velocity of migration of the ions. The charge of colloidal particles is probably to be attributed to associated ions, which determine the migration, diffusion, and steady suspension of the particles. [See also Abstract No. 688 (1904).] T. H. P.

626. Combined Sulphurous Acids. W. Kerp. (Arb. Kaiserl. Gesundheitsamt, 21. pp. 180-225, 1904. Chem. Centralblatt, 2. pp. 57-58, 1904. Abstract.)—The following table gives the dissociation constants of the compounds formed by sodium hydrogen sulphite with various aldehydic and ketonic substances:—

	N-solution.	N/10-solution.	N/30-solution.
Formaldehyde	0.18×10^{-6}	0.12×10^{-6}	0.11×10^{-6}
Acetaldehyde	2.84×10^{-6}	2.26×10^{-6}	2.06×10^{-6}
Benzaldehyde	—	1.00×10^{-4}	1.10×10^{-4}
Acetone	4.57×10^{-3}	4.8×10^{-3}	3.8×10^{-3}
Dextrose	311×10^{-3}	220×10^{-3}	124×10^{-3}

The amounts of free sodium hydrogen sulphite present, under similar conditions, in aqueous solutions of the compounds of acetaldehyde, benzaldehyde, acetone, and dextrose are respectively about 5, 31, 155, and 500-1,200 times as great as that contained in a solution of the formaldehyde compound. As it has been shown that the combined sulphurous acid in these compounds has no characteristic pharmacological effect and that their action in this direction is entirely due to the free sulphite, the poisonous actions can be estimated approximately by titrating the aqueous solutions with iodine. Determinations of the hydrolytic dissociation of dextrose sodium hydrogen sulphite by means of the polaristobrometer show that the normal and semi-normal solutions have practically identical dissociation constants, whilst the decinormal solution gives a far lower value. T. H. P.

627. Structure of Aluminium-Copper Alloys. W. Campbell. (Amer. Chem. Soc., Journ. 26. pp. 1290-1306, Oct., 1904. Columbia University.)—The series of aluminium-copper alloys containing from 0 to 54 per cent. of copper has a eutectic point corresponding with about 82 per cent. of copper. In alloys containing from 32 to 54 per cent. of copper, crystals of Al_2Cu occur in the eutectic mixture. When the proportion of copper present increases above 54 per cent., the amount of the compound Al_2Cu gradually diminishes, while a new constituent appears, at first in dendritic forms and later in irregular masses, its amount increasing until 78 per cent. of copper is present. Alloys with from 78 to about 88 per cent. of copper (from Al_2Cu_3 to AlCu_2) remain homogeneous. It is uncertain whether the new constituent is AlCu , Al_2Cu_3 , or AlCu_2 ; it may be that it contains two isomorphous compounds. Alloys containing from 88 to 90 per cent. of copper form solid solutions which at lower temperatures undergo a change, the nature of which depends on whether there is more or less than 87 per cent. of copper present, this corresponding with the eutectoid point. When from

92 to 100 per cent. of copper is present, the alloys form a series of solid solutions isomorphous with copper, and undergo no rearrangement in the solid state. A number of reproductions of microphotographs accompany the paper. [See also Abstract No. 2789b (1904).] T. H. P.

628. *Salt Formation in Solutions of Tautomeric Substances.* J. W. Brühl and H. Schröder. (Zeitschr. Phys. Chem. 50. pp. 1-42, Nov. 18, 1904, From Verhandl. des Naturhist.-mediz. Vereins in Heidelberg.)—The campho-carbonic acid esters (which act as weak acids) were taken as tautomeric substances of the acetoacetic ester type and the formation in absolute alcoholic solution of the salts (especially sodium salts) of these esters was studied by three spectrochemical methods. The procedure was as follows: Sodium was dissolved in a definite quantity of an absolute alcohol and a portion of the solution titrated to ascertain the exact strength. To the sodium alcoholate the equivalent quantity of the corresponding campho-carbonic acid ester was added. The initial substances (alcohol, sodium alcoholate, and ester) were optically examined before mixture, and the resulting product of mixture was examined in the same way. It was thus possible to ascertain by the three spectrochemical methods adopted: (1) whether by neutralisation the acid radical had changed its optical properties—in other words, whether it had undergone a chemical transformation (enolisation, ketisation); (2) whether the basic radical (metal or ammonium) had changed optically; (3) whether the difference of optical functions between salt and acid is equal to the constant which holds for the case of salt formation without chemical transformation, or is smaller than this or greater. Each of the three methods leads to a definite conclusion as to the constitution of the salt, and shows whether transformation has taken place and what is the nature of the transformation; the methods mutually control and supplement one another. The results of the investigation may be given in the form of the following statements: (1) In the neutralisation of the camphocarbonic acid esters by means of different sodium alcoholates, these esters undergo chemical transformation in every case. Not only in methyl and ethyl, but also in amyl alcoholic solutions is there a change from the ketonic ester, $C_8H_{11} \begin{matrix} \diagup CH \cdot CO_2R \\ \diagdown CO \end{matrix}$

to the enolic oxysalt $C_8H_{11} \begin{matrix} \diagup C \cdot CO_2R \\ \parallel \\ \diagdown C \cdot O \cdot Na \end{matrix}$. Thus, for the first time, the chemical

constitution of the much-discussed esters and ester salts of the acetoacetic ester and sodium acetoacetic ester types is firmly and indisputably established. (2) The optical function of the sodium is the same in dilute methyl and ethyl alcoholic solutions of the ester salts, but markedly different (the values are 20 per cent. less) from the function of the metal in equally dilute amyl alcoholic salt solutions. In concentrated salt solutions the optical values of the sodium are quite different from those in dilute solutions; they are, however—a very remarkable fact—exactly the same for all three solvents. The values are greater than for dilute solutions. The simplest satisfactory explanation of these facts is that the salts when dissolved in methyl or ethyl alcohol are ionised by sufficient dilution, whilst in amyl alcohol solutions there is no ionisation even at great dilution; in concentrated solutions there is an absence of ionisation whichever of the three solvents is used. This explanation was confirmed by osmotic and electrochemical experiments; ebullioscopic and conductivity measurements showed that the sodium salt of campho-

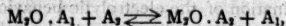
carbonic methyl ester is almost completely dissociated in methyl alcoholic solution. (8) The investigation of the sodium alcoholates brought to light the important fact that the function of the sodium in the alcoholates was exactly the same as in the corresponding ester salts, whatever the alcohol and whatever the concentration. From this we may conclude that the dilute methyl and ethyl alcoholic solutions of the alcoholates are ionised, but that the amyl alcoholic solutions are not dissociated. This assumption was confirmed by an examination of the electrolytic behaviour of the alcoholates. (4) As the optical function of the sodium in methyl or ethyl alcoholic solutions both of the ester salts and of the alcoholates changes with the dilution in the same way, we may assume that methyl and ethyl alcohols ionise the sodium compounds to approximately the same extent, and that the degree of ionisation corresponds to the magnitude of the optical function of the sodium. The optical function of the sodium can serve, then, as an expression and measure of the degree of dissociation. (5) The numerical value of the spectrochemical function of the sodium was also determined in aqueous solutions (dilute and strong) of sodium hydroxide. It was found that the sodium ion (in dilute aqueous solutions) gave almost exactly the same values as in dilute methyl and ethyl alcoholic solutions; the non-ionised sodium (in concentrated aqueous solutions) gave similarly the same values as in concentrated methyl, ethyl, and amyl alcoholic solutions of the ester salts and of the alcoholates. Throughout (for all wave-lengths) the optical function of the ionised sodium was from 12 to 15 per cent. smaller than that of the non-ionised sodium. (6) As a result of the close connection here proved to exist between spectro-chemistry, electrochemistry, and the new theory of solutions, we may now hope to be able to determine the degree of ionisation of a dissolved body by purely optical methods. (7) It has always been unknown and chemically inexplicable why camphocarbonic acid and its metallic and ethereal salts behave differently towards the same reagent, according as they are dissolved in benzene, ether, or ligroin on the one hand, or in methyl or ethyl alcohol on the other. We now see, from a physico-chemical examination (optical, osmotic, and electrolytic) that the condition of association or of ionisation, as the case may be, is the determining cause of the occurrence or absence of chemical transformation, and that this condition is dependent on the medial energy of the solvent in question.

D. H. J.

629. *New Formation of Colloidal Solutions and their Behaviour towards Barium Sulphate.* L. Vanino and F. Hartl. (Ber. Deut. Chem. Gesell. 37, pp. 3620-3628, Oct 22, 1904. Chem. Laborat. der Akad. der Wiss. München.) —*Aspergillus oryza* possesses strong reducing powers, and may be advantageously employed for the production of colloidal metal solutions. When this mould is sown in a solution of 0.01 gm. of gold chloride in 100 c.cm. of water, after a few days the liquid assumes a blue colour. In a solution of one-tenth the strength the mould brings about no reaction, whilst in one ten times as strong (0.1 gm. gold chloride per 100 c.cm.) a brownish-red, powdery deposit of gold is formed. Red colloidal gold is formed when an alcoholic solution of phosphorus is added to dilute gold chloride solution. On shaking solutions of various colloids, such as arsenic trisulphide, antimony sulphide, &c., with specially purified barium sulphate, and subsequently filtering the liquids, clear filtrates were obtained, showing that the barium sulphate exerts only a mechanical action. The authors regard colloidal solutions as containing suspended solid particles.

T. H. P.

630. *Affinity of the Alkali Oxides for Different Acid Anhydrides.* D. G. Gerassimoff. (Zeitschr. Anorg. Chem. 42. 3. pp. 329-340, Dec. 10, 1904. Laborat. für anorg. Chemie, Göttingen.)—The method employed was to pass a current of SO_2 or CO_2 at a definite (partial) pressure over the melted mixture kept at a definite temperature in a platinum crucible. Provided the melt remains homogeneous and the other anhydride is non-volatile, a definite state of equilibrium will be attained, represented by the reaction—



where M_2O = alkali oxide, and A_1 and A_2 denote the two anhydrides involved in the equilibrium. The avidity of the alkali oxides for the anhydrides CO_2 and SO_2 increases with the molecular weight of the alkali oxide as measured by the equilibria involving the anhydrides: (1) CO_2 and SiO_2 , (2) CO_2 and TiO_2 , (3) CO_2 and WO_3 , (4) CO_2 and V_2O_5 , (5) SO_2 and WO_3 , (6) SO_2 and V_2O_5 . Comparing the relative avidities of the non-volatile anhydrides, it is found that (a) V_2O_5 has a greater avidity than WO_3 (both measured against SO_2); (b) the following table gives the number of gm.-mols. CO_2 displaced from 2 gm. mols. Na_2CO_3 at 880° by 1 gm.-mol. of the different anhydrides, the partial pressure of the CO_2 being 0.07 atmosphere—

V_2O_5	Nb_2O_5	SiO_2	WO_3	Al_2O_3	TiO_2	Ta_2O_5
2.000	1.991	1.310	1.047	1.019	0.779	0.727

F. G. D.

631. *Studies on Comparative Cryoscopy.* Part II. *Aromatic Acids and their Derivatives in Phenol Solution.* P. W. Robertson. (Chem. Soc., Journ. 85. pp. 1617-1622, Dec., 1904.)—Extending his cryoscopic examinations of phenolic solutions [see Abstract No. 926 (1904)] to the aromatic acids, the author again finds that those acids which are most difficult to esterify show the smallest "rate" of association. Substitution in the ortho-position with respect to carboxyl, in general, reduces the rate of association, the lighter groups (OH , CH_3) exerting only a slight influence, but the heavier ones (Cl , Br , NO_2) causing a marked diminution. With di-ortho substituted acids there is practically no association, different substituent groups or atoms, whether heavy or light, having the same influence, which corresponds with V. Meyer's conclusion that di-ortho substituted acids yield no ester when treated in the cold with HCl and methyl alcohol. From the close connection between esterification and association it is probable that the former process is preceded by the formation of an unstable addition product between acid and alcohol. The amino-benzoic acids associate more rapidly than benzoic acid, owing to the union of a carboxyl of one molecule with the amino group of another. Acetoxy- and acetylamino-groups have a negative influence, the molecular weights of the compounds decreasing with the concentration of the solution.

W. H. St.

632. *Oceanic Salt Deposits.* XXXIX. *Transition-temperatures below 25° .* J. H. van't Hoff and W. Meyerhoffer. (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 54. pp. 1418-1421, Dec. 22, 1904.)—The following are the most important changes that take place in the equilibrium between the different salts at temperatures below 25° : (1) Under normal conditions, thenardite, Na_2SO_4 , changes into Glauber's salt, $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$, below 82.4° , but in presence of salt the transition-temperature is lowered to 17.9° and thenardite is then the

stable form at 25° C. In presence of glaserite, $(\text{NaK})_2\text{SO}_4$, the transition-temperature falls to 16·8°, in presence of astrakanite, $\text{Na}_2\text{Mg}(\text{SO}_4)_2 \cdot 2\text{H}_2\text{O}$, to 15·8°, and in presence of both salts to 13·7°. (2) As the temperature falls magnesium heptahydrate falls at the expense of the hexahydrate, whilst the latter displaces the monohydrate, so that finally only the heptahydrate appears in the equilibrium. The monohydrate, kieserite, $\text{MgSO}_4 \cdot \text{H}_2\text{O}$, disappears below 18°, whilst the hexahydrate vanishes at 18° C. Below this temperature the heptahydrate, $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, and the chloride, $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$, can exist together in equilibrium with the solution. (8) Leonite, $\text{MgK}_2(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O}$, can exist at 25° in equilibrium either with kainite, $\text{MgSO}_4 \cdot \text{KCl} \cdot 3\text{H}_2\text{O}$, or with schönite, $\text{MgK}_2(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$. Below 18°, however, it ceases to be formed,

25° C.

45° C.

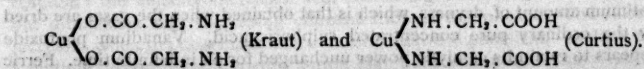
Bischoffite $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$		
Kieserite $\text{MgSO}_4 \cdot \text{H}_2\text{O}$		Carnallite $\text{MgCl}_2 \cdot \text{K} \cdot 6\text{H}_2\text{O}$
$\text{MgSO}_4 \cdot 6\text{H}_2\text{O}$	Kainite $\text{SO}_4\text{Mg} \cdot \text{KCl} \cdot 3\text{H}_2\text{O}$	Sylvine KCl
Reichardtite $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$	Leonite $(\text{SO}_4)_2\text{MgK}_2 \cdot 4\text{H}_2\text{O}$	
Astrakanite $(\text{SO}_4)_2\text{MgNa}_2 \cdot 4\text{H}_2\text{O}$	Schönite $(\text{SO}_4)_2\text{MgK}_2 \cdot 6\text{H}_2\text{O}$	
Thenardite SO_4Na_2	Glaserite $\text{SO}_4(\text{K}, \text{Na})_2$	

$\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$		
$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$		Carnallite
Glauber's salt	Kainite	Sylvine
	Schönite	
	Glaserite	

and kainite and schönite come directly into equilibrium with one another.

(4) In a similar manner the double salt astrakanite, $\text{MgNa}_2(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O}$, which at 25° appears as an intermediate stage between thenardite, Na_2SO_4 , and reichardtite, $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, disappears from the equilibrium at 45°, and there is then a direct equilibrium between reichardtite, $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, and Glauber's salt, $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$, the latter replacing the thenardite below 13·7°. (5) The change in the equilibrium between 25° C. and 45° is shown by the two diagrams reproduced above. T. M. L.

633. *Internal-complex Metallic Salts.* I. H. Ley. (Zeitschr. Elektrochem. 10. pp. 954-956, Dec. 23, 1904. Chem. Inst. der Univ., Leipzig.)—The electrolytic dissociation of copper salts decreases with the strength of the acid, as shown by the salts of the following acids: $\text{Cl}_3\text{CH} \cdot \text{COOH}$, $\text{CH}_2\text{Cl} \cdot \text{COOH}$, $\text{CH}_3 \cdot \text{COOH}$, $\text{CH}_3 \cdot \text{CH}_2 \cdot \text{COOH}$. The copper salt of glycocoll is very little dissociated, as shown by conductivity and freezing-point determinations, and two formulæ have been suggested for it, viz.—



The latter constitution is not probable, since amino-acids, in which the two hydrogen atoms of the amino-group have been substituted, also form copper salts. The author has prepared the copper salt of diethyl-aminoacetic acid, $(\text{C}_2\text{H}_5)_2\text{NCH}_2 \cdot \text{COOH}$, and also of piperidoacetic acid, $\text{C}_6\text{H}_{10} \cdot \text{N} \cdot \text{CH}_2 \cdot \text{COOH}$, and finds that their behaviour is similar to that of

copper glyccolate. They both give deep blue aqueous solutions. When ammonia is added to the solution of copper glyccolate a complex ammonia salt is formed, as was proved by partition experiments, but the colour of the solution is hardly altered. This salt probably contains the anion $\text{NH}_2 \cdot \text{CH}_2 \cdot \text{COO}$, and the kathion $\text{Cu}(\text{NH}_3)_n$, this conclusion being drawn from migration experiments; the blue zone containing the $\text{Cu}(\text{NH}_3)_n$ ion wanders to the kathode. Since the colour of aqueous solutions of these complex copper salts is similar to that of ammoniacal copper solutions the

author proposes the constitutional formula $\text{Cu} \begin{matrix} \text{O} - \text{CO} \cdot \text{CH}_2 \cdot \text{NH}_2 \\ \text{O} - \text{CO} \cdot \text{CH}_2 \cdot \text{NH}_2 \end{matrix}$, for copper

glyccolate, which is similar to that of the complex ammonia copper salts, $\text{X} \begin{matrix} \text{NH}_3 \\ \text{Cu} \\ \text{NH}_3 \end{matrix} \text{X}$, as formulated by Werner's theory. The $-\text{NH}_2$ group is con-

nected with the copper by so-called secondary valencies. The fact that the addition of ammonia to an aqueous solution of copper glyccolate hardly affects the colour, shows that the undissociated copper glyccolate, $\text{Cu}(\text{OCOCH}_2\text{NH}_2)_2$, and the ion $\text{Cu}(\text{NH}_3)_n$ absorb light to much the same extent. Similar results were obtained in the case of copper phenylglyccolate, and the aniline complex salt of copper acetate. T. S. P.

634. *Contributions to the Contact Process for Sulphuric Acid.* F. W. Kuster. (Zeitschr. Anorg. Chem. 42. 4. pp. 458-469, Dec. 80, 1904.)—This paper contains an account of the results so far obtained by the author on the combination of oxygen and sulphur dioxide under the influence of catalytic agents. The first part of the paper contains a description of the gasometer used for storing and delivering the mixed gases; it was so adjusted that the gases were delivered from it at a constant pressure, the fluctuations in the latter not being greater than 0.02 cm. of mercury. The liquid used for confining the gas was mercury. The hard glass tube containing the contact mass was heated in a horizontal, electrically heated, Heraeus furnace, and was so arranged that the part of the tube containing the contact mass remained at a constant temperature. The catalytic agents used consisted of vanadium pentoxide and ferric oxide, and the results obtained were compared with those of Knietzsch for platinum. In all cases it was found that the equilibrium attained between oxygen, sulphur dioxide, and trioxide was the same for the same temperature, that is, it is independent of the contact mass. Care, however, has to be taken that the gases remain long enough in contact with the catalyst for the true equilibrium to be attained. Platinum is by far the most active, and the only substance with which true equilibrium is reached in the time allowed in the technical process. Moisture has a great influence on the catalytic activity of the oxides of iron and vanadium; in both cases there is an optimum amount of dryness, which is that obtained when the gases are dried by the ordinary pure concentrated sulphuric acid. Vanadium pentoxide appears to retain its catalytic power unchanged for an indefinite time. Ferric oxide is very sensitive to mechanical and chemical influences; it is more and more poisoned by increasing quantities of arsenic. According to the author the explanation of the complete absorption of sulphur trioxide by concentrated sulphuric acid is as follows: 97-98 per cent. acid absorbs gaseous sulphur trioxide practically completely, without a fog of sulphuric acid forming, since there is practically no aqueous vapour over the acid. Dilute

sulphuric acid (and water) absorb the gaseous trioxide more completely, but the vapour space above these dilute acids contains enough aqueous vapour for the formation of very fine drops of sulphuric acid, which are charged with the trioxide, and these drops can be carried mechanically through a large number of wash-flasks. This also explains why the trioxide is absorbed with the most difficulty when it is very quickly cooled. The resulting fog consists of much finer particles than when slowly cooled, and these consequently deposit more slowly.

635. *Kinetics of the Process of Nitration.* H. Martinsen. (Zeitschr. Phys. Chem. 50, pp. 385-435, Dec. 30, 1904. From Doctor's Dissertation, University of Christiania, Feb., 1904.)—The velocity of nitration of nitrobenzene in concentrated sulphuric acid can be measured. Under the experimental conditions observed by the author the nitration does not proceed further than the formation of *m*-dinitrobenzene, even at 46°, whereas the experiments were carried out at 0° and 25°. In the case of quick reactions the velocity is measured by extracting the nitro-compound formed with ether, and then estimating its quantity by titration with stannous chloride in acid solution; in slow reactions the nitrometer can be used to follow the course of the reaction. The reaction is bimolecular at both the above-mentioned temperatures. Using 95 per cent. sulphuric acid the velocity constant at 0° is 0.085, and at 25° 1.5; that is an increase to 3.16 times its value for a rise in temperature of 10°. The value of the velocity constant and of the temperature coefficient depends, however, on the concentration of the sulphuric acid used as solvent. The constant does not increase continuously with the concentration of the sulphuric acid, but attains a maximum value at the concentration $\text{H}_2\text{SO}_4 \cdot 0.7\text{H}_2\text{O}$, which also corresponds approximately to the maximum conductivity. Nitrous acid has no effect on the nitration of nitrobenzene in sulphuric acid. The author has also made a number of experiments in order to determine the influence of the nature of the organic compound on the velocity of nitration. The experiments were carried out with 95 per cent. sulphuric acid. The introduction of the methyl group increases the velocity. At 25° a third nitro-group does not enter into the nucleus, but at 46° this takes place slowly in the case of 2:4-dinitrotoluene; the reaction is bimolecular, as also in the case of the nitration of mononitrobenzoic acid. The introduction of a carboxyl group lowers the velocity considerably, but not so much as the nitro-group. The influence depends on its position in the nucleus; the meta and para positions have six times the effect of the ortho position. If the acid character of the carboxyl group is diminished by esterification, its influence on the nitration velocity is also diminished. In the case of *p*-nitranilin two new nitro-groups are introduced with approximately the same velocity, picramide being formed. α -Nitronaphthalene is more easily nitrated than nitrobenzene.

The nitration of phenol in aqueous solution is a complicated autocatalytic reaction; the velocity increases with increasing concentration of the acid, but diminishes with increasing concentration of the phenol. The velocity increases when the dissociation of the nitric acid is diminished. Sodium and strontium nitrates have a greater action than potassium nitrate and sulphuric acid; thus there is also a specific action, besides the mere alteration of the dissociation. Nitrous acid is a strong positive catalyst; during the nitration nitrous acid is produced, and hence the auto-catalysis. If the formation of nitrous acid is hindered by the addition of urea no nitration occurs with small concentrations of nitric acid; strong nitric acid nitrates, however. Nitrophenol slightly increases the velocity, but much less so than nitrous acid; its

action is independent of the concentration, whereas the effect of concentration is marked in the case of the acid. The nitration of *p*-cresol is also of an autocatalytic character, the presence of nitrite increasing the velocity.

T. S. P.

636. *Desmotropic Compounds*. O. Dimroth. (Liebig's Ann. d. Chemie, 385. pp. 1-112, May 26, 1904. Zeitschr. Elektrochem. 11. pp. 33-84, Jan. 18, 1905.)—In conjunction with E. Eberhardt and E. Letsche the author has investigated some triazole compounds. Malonic acid, methyl ester, and diazobenzolamide yield an enolic ester which can easily be converted into the isomeric keto-ester, and sodium ethylate transforms the latter back into the former. The former can be titrated with potassium iodide and iodate. When dissolved in ether, benzene, or chloroform, the enolic modification is completely isomerised; in methyl alcohol equilibrium is reached when the esters are in the proportion 1 enolic to 300 keto-ester; in water with the proportion 1:14. The velocity constants or coefficients of isomeration, k , in the different solvents are at 25°: in water, 0.000028; in methyl alcohol, 0.0053; in ether, 0.18; in chloroform, 0.27; and the temperature coefficients of k are abnormally high. The velocity of reaction appears thus to be smallest in the strongly dissociated solvents, while in the cases so far studied the coefficient of isomeration increases with the dissociating power of the solvent. The author hence concludes that in this case the non-dissociated portions are chiefly concerned, and this is supported by further experiments. The duration of the complete oscillation period: enol $\rightarrow$ keto $\rightarrow$ enol modification, varies with the solvent between 20 days and 15 months.

H. B.

637. *Desmotropic Compounds*. H. Goldschmidt. (Zeitschr. Elektrochem. 11. pp. 5-7, Jan. 6, 1905.)—The author criticises Dimroth's conclusions [see preceding Abstract]. The coefficient of isomeration k may increase with increasing concentration of the enolic modification, and on the addition of electrolytes with the same ion (sodium derivative of the enolic ester). But such observations do not justify, as Goldschmidt and Wegscheider have shown, any conclusions as to the relative parts played by the dissociated and the non-dissociated constituents; for whether the ions take part or not, k would in either case be proportional to the concentration of the non-dissociated portions—though not with the same constant. Referring to his formulæ on the saponification of methyl acetate, the author confirms most of Dimroth's calculations; certain peculiarities could be explained by the accelerating influence of a liquid phase of the keto-ester [see Abstract No. 670 (1900)].

H. B.

638. *Density and Alteration in Volume and Physico-chemical Behaviour of Sulphuric Acid in Aqueous Solution*. J. Domke and W. Bein. (Zeitschr. Anorg. Chem. 43. 1. pp. 125-181, Jan. 16, 1905. Extract from Vol. 5 of Wiss. Abhandl. der Normal-Eichungskommission, Berlin-Charlottenburg.)—The authors give the results obtained in an extended investigation of the effect of concentration on the physical and chemical properties of solutions of sulphuric acid. Complete tables are given showing the connection between concentration and the density and volume of solutions, and the results are compared with those of numerous other investigators, with which they, in general, show a very good agreement. A very complete summary of the literature is also given. The authors conclude that the existence of a monohydrate, and probably also of a dihydrate, is tolerably certain, while hydrates

containing 4 and 6 molecules of water are doubtful. One hundred per cent. sulphuric acid, which can only be obtained by the solution of sulphur trioxide in concentrated sulphuric acid, is not a definite compound, but a mixture of sulphuric acid, water, and sulphur trioxide, or else of the dihydrate of sulphuric acid and its products of dissociation. T. S. P.

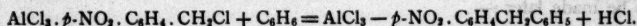
639. *Solubility of Lithium Carbonate in Alkali Salt Solutions.* G. Geffcken. (Zeitschr. Anorg. Chem. 48. 2. pp. 197-201, Jan. 25, 1905. Physikal. Chem. Inst. der Univ., Leipzig). The influence of alkali salts on the solubility of lithium carbonate is shown by the accompanying table :—

Gm. Equivalents of added Salt per Litre.	KNO ₃	KCl	NaCl	$\frac{K_2SO_4}{2}$	$\frac{Na_2SO_4}{2}$	NH ₄ Cl	$\frac{(NH_4)_2SO_4}{2}$
0.1		0.8558	0.8569			0.8902	
0.25	0.8647	0.8590	0.8691	0.4028		0.4677	0.5059
0.5	0.8688	0.8782	0.8867	0.4356	0.4411	0.5659	0.7868
0.75	0.8676	0.8832	0.8956			0.6270	
1.00	0.8656	0.8835	0.8946	0.4860	0.4926	0.6810	0.9804
1.50	0.8490	0.8781	0.8901			0.7468	1.109
2.00	0.8268	0.8558	0.8776		0.5584	0.7789	1.174
4.00						0.7881	
	KClO ₃						
0.1	0.8500						
0.2	0.8570						
0.4	0.8616						

The solubility in water at 25° is 0.8415 equivalents per litre.

T. M. L.

640. *The Reaction of Friedel and Crafts.* J. Böeseken. (Konink. Akad. Wetensch. Amsterdam, Versl. 13. pp. 468-471, Jan. 5, 1905. Proc. 7. pp. 470-473, Jan. 25, 1905.)—The author classifies the different cases in which aluminium chloride acts as a catalyser. The classes are: I. The aluminium chloride combines with none of the reacting substances—catalytic action in truest form, e.g., chlorination or bromination of benzene. II. The aluminium chloride combines with the chloride to a more or less strong additive product. (a) The catalyser is situated close to the place where condensation occurs, e.g., $CH_3.COCl.AlCl_3 + C_6H_6 = CH_3.COC_6H_5.AlCl_3 + HCl$. (b) The aluminium chloride is combined with the chloride, but not near the place where the condensation occurs, e.g.,—

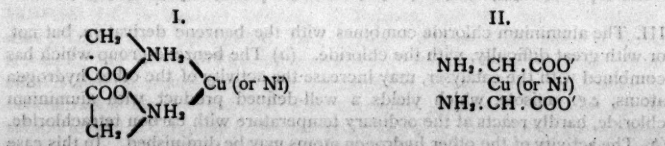


III. The aluminium chloride combines with the benzene derivative, but not, or with great difficulty, with the chloride. (a) The benzene-group which has combined with the catalyser, may increase the activity of the other hydrogen atoms, e.g., anisole, which yields a well-defined product with aluminium chloride, hardly reacts at the ordinary temperature with carbon tetrachloride. (b) The activity of the other hydrogen atoms may be diminished. In this case the reaction does not take place, e.g., nitrobenzene, &c., do not suffer condensation with carbon tetrachloride, chloroform, &c. IV. The aluminium chloride unites both with the chloride and the benzene derivative. Condensation may or may not take place, according to the groups present. V. The aluminium

combines only with the product of condensation. In this case a molecular quantity of aluminium chloride will be required. The author finds that in presence of aluminium chloride, sulphur and benzene interact according to the equation $S_8 + 6C_6H_6 + 3AlCl_3 = 2(C_6H_5)_2S \cdot AlCl_3 + (C_6H_5)_2S_2 \cdot AlCl_3 + 4H_2S$. The author recommends especially investigation of these various classes of reaction. A. F.

641. *Liquid Mixed- and Layer-Crystals.* O. Lehmann. (Ann. d. Physik, 16. 1. pp. 160-165, Jan. 25, 1905.)—The phenomena of liquid crystals are shown by *p*-methoxybenzaldazine or anisaldazine, and striking observations were made on the behaviour of mixtures of this substance with methoxycinnamic acid. Thus, on adding the azine to a drop of the acid on a microscope slide between crossed nicols, the crystal-drops suddenly change in appearance in almost exactly the same way as a dimorphous substance when undergoing transformation. These results do not, however, appear to be due to dimorphism in the liquid crystals, but rather to a partial miscibility of the two substances when in this condition. Thus on adding a little of the azine to the acid the liquid crystals remain homogeneous until the limit of miscibility is reached; subsequent addition of the azine causes the separation of a layer consisting chiefly of this substance, but this second phase, instead of forming separate drops, appears in the form of a thin skin on the surface of the first type of liquid crystals. This alteration in the surface of the drops causes a complete rearrangement of molecular structure which manifests itself in the changed interference figures. T. M. L.

642. *Copper and Nickel Salts of some Amino-Acids.* G. Bruni. (Zeitschr. Elektrochem. 11. pp. 93-94, Feb. 3, 1905. From the Allgem. Chem. Inst. der Univ., Bologna.)—The author, in the case of certain α -amino copper and nickel salts of fatty acids, came to the conclusion that the metallic iron in these salts exists within a complex similar to that known for the compound ammonias. This conclusion was based chiefly on two facts, viz.: (1) The colour of the aqueous solutions. This colour is identical with that of the corresponding Cu- or Ni-ammonium compounds, and scarcely alters on addition of ammonia. (2) The absence of the principal reactions characteristic of real salts of the metals. To a minor extent the conclusion was supported by cryoscopic observations which showed the compounds in question to be scarcely dissociated in solution. No emphasis is to be laid on the cryoscopic results, as they are equally well interpreted as depending on the weak character of the bases and (especially) acids. To explain the facts the author suggested one of two formulæ, leaving the final choice to be made later:—



Recently Ley has published similar work to the above on the subject of copper glycolate, and has formed analogous conclusions to those of the author, who in the present paper enters into a controversy on some points. [See Abstract No. 638 (1905).] D. H. J.

643. Fluidal Metals. P. Duhem. (*Journ. de Chimie Physique*, 2. 7. pp. 488-448, 1904).—Spring has recently shown that when highly compressed, metals assume an allotropic form, which he terms the fluidal metal and distinguishes from the ordinary form obtained by cooling the molten metal, which he calls the annealed metal. Annealed and fluidal bismuth form a couple in which the latter is the kathode, so that at the ordinary temperature and pressure the fluidal bismuth is in true equilibrium and the annealed bismuth in pseudo-equilibrium. At high temperatures, however, the fluidal metal is converted into the annealed form, while under high pressures the annealed metal becomes transformed into the fluidal modification, this latter change being accompanied by evolution of heat. These facts indicate that the two forms of bismuth give an equilibrium curve (pressures as ordinates and temperatures as abscissæ), which ascends from left to right and cuts the axis of zero pressure at a high temperature. If, in the case of other metals, the reversible transformation is endothermic, the curve will be of the same form, but for all metals examined up to the present the curves cut the horizontal axis at a high pressure; if the transformation is endothermic, the curve descends from left to right. T. H. P.

644. Structure of Certain Ternary Alloys of Tin and Antimony. W. Campbell. (*Amer. Chem. Soc., Journ.* 26. pp. 1806-1815, Oct., 1904. Columbia University).—The author describes a number of alloys prepared by mixing an alloy of 25 per cent. of antimony and 75 per cent. of tin (which contains cubes of the compound $SbSn$ distributed throughout its mass) with lead, cadmium, bismuth, copper, silver, zinc, arsenic, and aluminium. According to their structure, the ternary alloys obtained may be divided into three groups: (1) Those in which cubes of $SbSn$ occur in a basis of dendritic tin, surrounded by the eutectic alloy of tin and the third metal—lead or bismuth. (2) Those in which cubes of the compound $SbSn$ and crystals of a compound of tin with the third metal occur in the eutectic mixture of tin and the second of the two compounds mentioned—copper or silver. (3) Those in which a compound of antimony with the third metal is formed; the ground mass here consists, in the case of aluminium, of crystals of the latter in its eutectic alloy with tin, and in the cases of zinc and possibly cadmium, of crystals of $SbSn$ and a solid solution rich in tin. Arsenic probably belongs to a sub-section of group (2), in which the compound $SbSn$ and crystals of a compound of tin and the third metal occur in a ground mass consisting of a solid solution of tin. It is possible that most of the eutectic mixtures are not binary, but contain the third metal, which is, however, not detectable by means of the microscope. [See also Abstract No. 2769 (1904).]

T. H. P.

645. Microstructure of Annealed Steel. W. Kurbatoff. (*Jurn. Russk. Fizik. Khimichesk. Obščestva*, 36. No. 8a. pp. 1110-1112, 1904).—This paper is given up to investigating the various etching substances which might be used for ascertaining the different structural constituents of steel, it being shown that the rate of etching is about proportional to the degree of electrical dissociation. Solutions in water give rather unsatisfactory results, while solutions in a non-dissociated liquid do not lead to any colouring effect. If there be added to the active caustic liquid some $C_6H_5(NO_2)(OH)$ or a similar substance, the effect of the caustic is altered so as to warrant the conclusion that the coloured fracture has a complicated composition. The results of the investigation can be summarised as follows: 1. A 5 per cent. solution of nitric

acid in isoamylic alcohol was tested and found to be the most sensitive of all those experimented on, allowing the structure of soft steel, brittle and not brittle, to be distinguished from the lamellar structure of nickel steel. 2. A mixture of 1 part of a 4 per cent. solution of the same nitric acid in acetic anhydride and one part of methyl, ethyl, and amyl alcohols was found, after acting for 7 to 10 min., to colour only troostite and sorbite, leaving the remaining constituents unaltered. The problem as to a possible difference in hardness between austenite and martensite was next investigated, it being shown that the hardness of the crystals regarded as austenite is different not only in different specimens but even in the same specimen. The structure of steel containing high percentages of carbon (1.9 per cent. C) was next studied in connection with tempering, the following being recognised: (1) On being tempered at different instants of the transition period (A_{r1} , $\dots$) this steel consists of sorbite and cementite. (2) With high temperatures dark crystals on a bright background and troostite, and with still higher ones bright crystals on a dark background are obtained. (3) During annealing martensite is separated into plates of cementite, troostite being converted into cementite. Austenite is converted into troostite. (4) On raising the annealing temperature, the following reaction is found to take place: troostite + cementite is converted into ferrite + cementite, while the percentage of cementite is increased. The author is inclined to think that all the constituents of steel, being solid solutions of carbides and carbon in iron, may crystallise in large crystalline aggregates of the same system. A. G.

646. Copper, Tin, and Oxygen. E. Heyn and O. Bauer. (Königliches Materialprüfungsamt, Berlin, Mitth. 22. pp. 137-147, 1904.)—Describes investigations on the part played by oxygen in copper-tin alloys, both when intentionally introduced in the form of cuprous oxide, when allowed to enter freely from the air and when partly prevented from entering by a layer of charcoal over the fusion. The paper is illustrated by 16 photo-micrographs. The authors summarise their conclusions as follows: (1) Oxygen occurs in copper-tin alloys in the form of crystals of stannic acid, which are insoluble in the molten alloy and remain in suspension in its mass. At times these crystals degenerate into films, which in that case are always found enclosed in the most fusible constituent of the alloy, which is rich in tin. Such an admixture of stannic oxide renders the fused metal viscous. (2) In the fused state the following reaction takes place between cuprous oxide and metallic tin: $2Cu_2O + Sn = 4Cu + SnO$, so that cuprous oxide cannot exist in an alloy containing metallic tin. (3) A covering layer of charcoal during fusion does not necessarily exclude the formation of stannic oxide in copper-tin alloys. An addition of phosphorus is an effective means of removing the oxide when once formed. (4) When copper-tin alloys are melted with free access of air, an upper layer is first formed consisting of copper containing cuprous oxide and inclusions of stannic oxide; below this is a layer of copper-tin alloy which also contains stannic oxide. If the mass is kept in fusion long enough, the entire lower layer disappears, the whole of the tin being converted into oxide. (5) Analytical separation of the metallic tin from the stannic oxide can be effected by dissolving the alloy electrolytically in dilute sulphuric acid; metallic tin is dissolved while stannic oxide remains as a solid residue. (6) The films of stannic oxide in copper-tin alloys bear some resemblance to the films of alumina found in steel which has been de-oxidised by means of aluminium. (7) Molten tin is unable to dissolve stannic oxide which

crystallises out. (8) The grey and yellow spots seen on fractures of tin bronzes are not due to extensive segregation, but are due to the large size of the constituent grains formed during slow solidification. After rapid solidification the fracture shows a uniform mixed tint. W. Ros.

647. *Alloys of Zinc and Antimony.* K. Mönkemeyer. (Zeitschr. Anorg. Chem. 43. 1. pp. 182-196, Jan. 18, 1906. Inst. für anorg. Chemie der Univ., Göttingen.)—The work of Cooke, Herschkowitsch, and Roland Gosselin having given partially contradictory results as to the existence of chemical combinations between zinc and antimony, the author has determined a complete temperature-concentration diagram by the aid of cooling-curves and micro-sections. The cooling-curves were obtained by timed readings of a thermoelectric temperature indicator, and initial freezing-points as well as subsequent arrest-points were found. The duration of the arrests, particularly of those corresponding to the solidification of eutectics, was carefully determined, since the duration of solidification of a eutectic should approach zero as the composition of a pure compound is approached. The data of the cooling-curves, and the complete temperature-concentration diagram are given and fully discussed in the paper, which is also illustrated with micro-sections of four of the alloys. The existence of the compounds Zn_3Sb_2 and ZnSb is confirmed by the results obtained, but the other supposed compound containing about 85 per cent. Zn, and Herschkowitsch's compound ZnSb_2 cannot exist. W. Ros.

648. *Transport Number of Sulphuric Acid.* O. F. Tower. (Amer. Chem. Soc., Journ. 26. pp. 1089-1095, Sept., 1904. Adelbert College of Western Reserve Univ., Cleveland.)—The following are the values obtained by the author for the transport number of sulphuric acid at different temperatures:—

Concentration.	8°.	20°.	32°.
N	—	187.7	—
$\frac{1}{2}$ -N	—	186.9	—
$\frac{1}{5}$ -N	—	180.5	—
$\frac{1}{10}$ -N	164.4	176.4	191.7
$\frac{1}{20}$ -N	163.7	179.1	191.6
$\frac{1}{50}$ -N	168.1	180.9	191.2

The accuracy of the determinations apparently increases as the dilution increases to N/20, after which it diminishes owing to disturbances caused by the manipulation of the solution and the flow of the current. The results at 20° show that the transport number at first decreases with the concentration and then increases, especially between 10° and 20°. No increase is observed between these concentrations at 8° or 32°, but an increase appears at N/50 for these temperatures. The values for the three most dilute solutions are sufficiently constant to show either that no HSO_4 ions exist at concentrations less than N/10 or that compensation takes place in the dissociation of ions possibly even more complex than HSO_4 . In dilute solution at 20° sulphuric acid has the average transport number 178.8, the temperature coefficient being 1.1. The results of other investigators are discussed. T. H. P.

649. The Halogen Hydrides as Conducting Solvents. III. The Transport Numbers. B. D. Steele. (Roy. Soc., Proc. 74. p. 820, Jan. 28, 1905.)—The transport numbers were determined for solutions in liquefied hydrogen bromide of ethyl ether, acetone, methyl hexyl ketone and triethylammonium bromide, the first two of which have been shown to form compounds with hydrogen bromide. The validity of Faraday's law for solutions in hydrogen bromide was first tested by a direct comparison of the amount of hydrogen evolved during the electrolysis of various substances in hydrogen bromide solution, with the weight of silver deposited at the kathode of a silver voltmeter. Concordant results were obtained. The transport numbers were determined by the method of Hittorf at a temperature of -81° . The following mean values were found for the kation:—

Ether.....	$n = 1.0,$	$p = 0.82$
Triethylammonium bromide ..	$n = 0.5$ to $0.75,$	$p = 0.20$
	$n = 1.04,$	$p = 0.85$
Acetone.....	$n = 1.0,$	$p = 0.88$
	$n = 1.8,$	$p = 0.95$
Methyl hexylketone	$n = 0.9,$	$p = 0.39$
	$n = 1.8,$	$p = 0.77$

where n = concentration in gm.-mols. per litre, p = kation transport number. The experiments show that the kation transport number increases with increasing concentration, and that the ether (or acetone, &c.) functions as the kation or as a component part of it. [See also Abstract No. 2225 (1904).] T. M. L.

650. The Halogen Hydrides as Conducting Solvents. IV. B. D. Steele, D. McIntosh, and E. H. Archibald. (Roy. Soc., Proc. 74. pp. 821-822, Jan. 28, 1905.)—Conducting solutions in which the halogen hydrides and sulphuretted hydrogen act as solvents yield abnormal values for the molecular conductivity, and show an enormous diminution of μ with dilution, instead of the steady slow increase required by the theories of Arrhenius, van't Hoff, and Ostwald. These abnormal results can be explained on the assumption that the dissolved substance enters into combination with the solvent, and that the resulting compound undergoes ionic dissociation. It can be shown from the law of mass action that, if n molecules of solute combine with m molecules of the solvent to form a single molecule of the electrolyte, the concentration of the latter will be proportional to ν^{-n} , where $\nu^{-1} = c$ is the concentration of the original dissolved substance. But the specific conductivity κ is proportional to the number of ions, and this is proportional to the concentration of the electrolyte multiplied by a , where a is its coefficient of ionisation. Thus $\kappa = aKc^n = aK/\nu^n$, if $n = 2$, $\kappa\nu^2 = aK$. If a varies but slightly over a given range this equation becomes $\kappa\nu^2 = K'$. In some cases $\kappa\nu^2$ is approximately constant over a certain range of dilution; and that this approximate constancy does not hold at greater dilutions is to be assigned to the variation of a , which may become greater in more dilute solutions on account of a secondary dissociation intervening. [See also Abstract No. 2225 (1904) and preceding Abstract.] T. M. L.

651. Electrical Method for Estimation of Carbon Dioxide. G. Bodländer. (Chem. Zeit. 28. p. 928, 1904. Elect. Rev. 55. p. 609, Oct. 14, 1904. Paper read before the Physical and Chemical Section of the Gesell. Deutsch.

Naturforscher und Aertze.)—The process depends upon a measurement of the acidity which is conferred upon an aqueous solution by a current of carbon dioxide. When a gaseous mixture containing carbon dioxide is led through water, the liquid takes up a quantity of the gas corresponding with the partial pressure of the CO_2 . To a small extent the dissolved CO_2 dissociates into the ions H^+ and HCO_3^- ; and the ratio—

$$[\text{H}^+].[\text{HCO}_3^-] = 12.6 \times 10^{-9} [\text{CO}_2],$$

in which $[\text{H}^+]$ and $[\text{HCO}_3^-]$ are the concentrations of the two ions in gm.-mols. per litre. If the solution is very acid, the concentration of the H^+ -ions derived from the carbonic acid is but slightly altered; and if the solution is neutral, an equal amount of H^+ and HCO_3^- ions are produced. Then $[\text{H}^+].[\text{HCO}_3^-] = [\text{H}^+]^2$; i.e., the square of the concentration of the H^+ -ions is proportional to the partial pressure of the carbonic acid. This proportionality is most accurate when the liquid contains bicarbonate; then $[\text{H}^+]$ is proportional to $[\text{CO}_2]$. The acidity can be measured very exactly by observing the electromotive force. In order to use this principle in measuring the partial pressure of CO_2 , the following electrical system is employed: $\text{Ag} | \text{AgCl} | \text{KCl} + \text{KHCO}_3 + \text{K}_2\text{SO}_4 | \text{Pt}$. The energy of the reaction in this system, and its e.m.f., depend on the concentration of the potassium chloride and bicarbonate in solution, and on the amount of O and CO_2 in the gaseous mixture. The e.m.f. increases with the amount of CO_2 in the gas; the increase being the more conspicuous as the amount of CO_2 is the smaller. Hence this electrical method may be employed for the estimation of CO_2 , instead of the usual gas-volumetric process, which is very inexact in low concentrations. The operation is so delicate when small quantities of the gas have to be determined, that it is very servicable in examining products of combustion or ordinary air, and for making continuous tests upon the atmosphere of mines. The author accompanied his paper by a demonstration.

J. B. C. K.

652. *Jacques' Cell.* F. Haber and L. Bruner. (Elect. Rev., N.Y. 45, pp. 514-515, Oct. 1, 1904. Paper presented to Section C. (Electrochemistry) at the St. Louis International Electrical Congress, 1904.)—Iron in fused sodium hydrate becomes passive owing to a coating of oxide. This coating is caused by the presence of sodium manganate, which is always present in commercial sodium hydrate; and even if the latter is pure, manganese is a usual impurity in commercial iron. Passive iron as an unattackable electrode may be replaced by platinum. This gives an uncertain potential in pure sodium hydrate unless a small quantity of manganate is added. The potential is thus brought about by absorption of oxygen. Potential measurements were made against a decinormal electrode, the syphon of which terminated in a vessel containing concentrated sodium hydrate solution; this was connected to the fused hydrate by a rod of solid sodium hydrate. The figures for a platinum electrode with a little manganate vary from -0.265 volt at 812°C . to -0.472 at 582° . A carbon electrode gives the values -0.6 to -1.5 volts, the latter value being the more nearly approached as the carbon is more readily attacked, and is therefore more surrounded by hydrogen gas. If a platinum tube is dipped into fused sodium hydrate and pure hydrogen gas is led through it into the liquid, the value -1.5 volts is obtained if the current of gas is strong enough. The potential of the carbon is therefore determined by the hydrogen, not by the carbon. The action of CO on fused

sodium hydrate is to form carbonate with evolution of hydrogen. The authors therefore conclude that Jacques' cell is merely a hydrogen-oxygen cell, and that thermoelectric phenomena take no part in its action. The cell in practice is an expensive way of making sodium carbonate. W. R. C.

653. Electrolytic Solution of Platinum and Preparation of Barium Platinocyanide. A. Brochet and J. Petit. (Zeitschr. Elektrochem. 10. pp. 922-924, Dec. 2, 1904. Chem. News, 90. pp. 810-811, Dec. 23, 1904. Bull. Soc. Chim., 81, No. 12. Communication from the Laboratoire d'Electrochimie, Ecole de Physique et de Chimie industrielles de Paris.)—The authors give in the last two journals further particulars [see Abstracts Nos. 1844, 2882, 2788 (1904), and 327 (1905)] about the dissolution of platinum in solutions of KCN and Ba(CN)₂ by alternating currents of from 20 to 60 amps. per sq. dm.; the frequency is not stated. The first communication describes the preparation of barium platinocyanide. An excess of Ba(OH)₂ is dissolved on the water bath in HCN, and the liquid electrolysed at 50° C. with platinum electrodes of 5 × 10 cm., 0.1 cm. in thickness. If the electrolyte is afterwards crystallised while CO₂ is passed through the liquid in order to decompose the Ba(CN)₂, the resulting barium platinocyanide has a faint fluorescence. In the presence of Ba(CN)₂, green, strongly fluorescent crystals are obtained, but Dammer's formula, Pt₂(CN)₈Ba₆·22H₂O, does not appear to be correct. H. B.

654. Passivity of Metals. W. Muthmann and F. Frauenberger. (Kgl. Bayer. Akad., Ber. 34. pp. 201-241, 1904. Zeitschr. Elektrochem. 10. pp. 929-980, Dec. 9, 1904.)—In addition to iron, chromium, nickel, and cobalt, the metals molybdenum, vanadium, tungsten, niobium, and ruthenium are also capable of being rendered passive, whilst with uranium and manganese this is not the case. The method used by the author in investigating this phenomenon is that given by Hittorf, namely, the measurement of the e.m.f. towards a normal electrode (Hg, HgCl, *n*-KCl), the electrolyte being in all cases *n*-KCl solution. The metals to be examined are subjected to the action of the solution capable of rendering them active or passive, after which they are washed and their e.m.f.'s measured as above. It is found, in agreement with older observations, that oxidising agents, and especially oxy-acids, render metals passive, the greatest action being with anodic treatment, whilst cathodic polarisation of metals in acid, salt or alkali solutions, raises the potential, i.e., renders them active. The lowest potentials are given after several hours' standing in concentrated chromic acid, and the highest after cathodic treatment in strongly cooled alkali solution. Metals become passive on lying in the air, and their potentials assume medium values, whilst vigorous mechanical cleaning of the surface renders them active. The authors assume that, under all circumstances, the passivity is conditioned by the oxygen of the oxidising agent or of the air. By modifying Fredenhagen's theory of gaseous charges they arrive at the view that the oxygen forms a solid solution in the metal, and that the concentration of this solution increases with the oxidation-pressure of the agent employed. The potential measured is hence that of a metal-oxygen alloy. T. H. P.

655. Electrolytic Estimation and Separation of Antimony and Tin from Sulphosal Solutions; Antimony Trisulphide. A. Fischer. (Zeitschr. Anorg. Chem. 42. 3. pp. 368-417, Dec. 10, 1904. Elektrochem. Inst. d. Kgl.

techn. Hochschule, Aachen, Sept., 1904.)—The electrolytic reduction of tin can easily be effected quantitatively from solutions of tin ammonium-sulphate containing some sodium sulphite, with a tinned platinum cathode and an anode of platinum-iridium; platinum is corroded, though not re-deposited. Antimony can be reduced from sulphantimonite, in which the equivalent is Sb/8, or from sulphantimoniate (Sb/5) in solution of sodium sulphide, containing potassium cyanide to destroy any polysulphides. The separation of the two metals is effected under the conditions just mentioned, the sodium sulphide being saturated at 80° and mixed with some caustic soda (Classen) to diminish the hydrolysis of this sulphide; the temperature must not exceed 80°, the tension not 1.1 volt. In the absence of potassium cyanide the separation from tin succeeds only with trivalent antimony, with 0.9 volt, in solutions of sodium sulphide saturated at 60°. The separation fails in solutions of sodium sulphhydrate, as the potentials of the two metals differ too little in this solution. F. Henz had recommended the precipitation of the two metals from oxalate solutions, and determination of antimony as trisulphide, because the electrolytic determination of antimony appeared to give too high values. The author finds that the fault lies with the sulphide, which contains more Sb than corresponds to the formula Sb_2S_3 . Rotation of the anode and agitation of the electrolyte do not quicken these electrolytic determinations. H. B.

656. *Physico-chemical Studies of So-called Explosive Antimony. II.* E. Cohen, E. Collins, and T. Strengers. (Zeitschr. Phys. Chem. 50. pp. 291-308, Dec. 20, 1904. van't Hoff-Laboratorium, Utrecht, July, 1904.)—As the electrolytic deposition of antimony has been used by Pfeifer and Popper for the determination of the atomic weight of that element, the authors, led by their previous work, first investigated whether Faraday's law applies without complication to this metallic deposition of antimony. Acidified solutions of carefully purified antimony trichloride, of varying concentration, were electrolysed, and in the circuit two silver coulometers (voltameters) were placed. It was found that change of temperature at which the electrolysis was carried out had a very slight influence on the equivalent weight of antimony found. The concentration of hydrochloric acid in the solution, however, has a not inconsiderable effect on the value of the calculated equivalent of antimony. Experiments were also carried out with methyl alcohol solutions, and similar results obtained. Experiments were also carried out with aqueous solutions (acidified) of antimony tribromide and tri-iodide, and results obtained similar to those with the trichloride. It is evident, therefore, that the statement of Pfeifer that the amounts of metallic antimony deposited are proportional to the amounts of silver deposited by the same current, is not correct. Experiments were also carried out with the trifluoride, since from solutions of this, non-explosive antimony is deposited; but even in this case the estimated equivalent weight of antimony increases with increasing concentration of the solutions. The electrolytic method therefore cannot be employed for the determination of the combining weight of antimony. The deviations from Faraday's law are ascribed to the presence of divalent antimony ions. [See also Abstract No. 1205 (1904).] A. F.

657. *Electrolytic Deposition of the Most Important Metals, the Electrolyte being vigorously stirred.* A. Fischer and R. J. Boddaert. (Zeitschr. Elektrochem. 10. pp. 945-968, Dec. 28, 1904. 20th Communication on Electroanalysis from the Elektrochem. Inst. der k. techn. Hochschule zu Aachen.)—

The authors have investigated the influence of vigorous stirring of the electrolyte on the time taken in the deposition of the most important metals, the rate of deposition being increased by increasing the current strength. The results are summarised in the following table:—

Metal.	(a) Time (no Stirring)	(b) Time (Stirring)	Time Ratio, a:b	Metal.	(a) Time (no Stirring)	(b) Time (Stirring)	Time Ratio, a:b
	In Hours.	In Minutes.			In Hours.	In Minutes.	
Nickel.....	3	40	4.5	Silver.....	3	15	12
Zinc.....	2	15	8	Mercury.....	1	15	10
Copper.....	6	90	18	Antimony.....	1	30	4
Cadmium.....	3	10	18	Tin.....	6	30	18
Lead.....	1	15	4				

"Nickel" is deposited from an ammonium oxalate solution. In the case of "Zinc" Classen's oxalate method cannot be used. Good results are obtained with an electrolyte of sodium acetate and acetic acid; the best deposit, which also gives the most accurate results, is from an alkaline solution containing potassium cyanide. "Copper" can be deposited from a nitric acid solution, which may, or may not, contain sulphuric acid. For the deposition of the last traces it is necessary to add ammonia. Exact results cannot be obtained with "Bismuth." "Cadmium" cannot be deposited from the oxalate solution to give exact results; a sulphuric acid solution can be used. "Lead" gives good results with a nitric acid solution; this is also the case with "Mercury." A potassium cyanide solution is used for "Silver." "Antimony" is deposited from the sodium sulphide solution. "Tin" gives good results from an ammonium sulphide solution, but not by the oxalate method. The paper also contains a description of the special apparatus used. [See also Abstracts Nos. 2799 and 2880 (1904).] T. S. P.

658. *Measurement of Electrode Potential and of Changes of Concentration at the Kathode during Electrolysis of Stationary Liquids.* H. J. S. Sand. (Faraday Soc., Trans. 1. pp. 1-23; Discussion, pp. 24-25, Jan., 1905. Phil. Mag. 9. pp. 20-41, Jan., 1905.)—In order to investigate the interdependence between electrode potential and current density, the author elaborated a method for measuring potentials in stationary electrolytes of known concentration free from convection currents. The electrodes are placed horizontally, the kathode resting in liquids which become lighter during electrolysis on a carefully levelled, perforated glass plate at the top of a tube leading down to the anode chamber; in liquids becoming heavier the kathode is placed at the bottom. The liquid connection to the normal electrode is tapped off about 3 mm. in front of the electrode, and the resistance between the junction and the electrode calculated or determined on a bridge for alternating currents combined with condensers (Nernst-Haagen). Experiments were made in aqueous solutions of copper and zinc sulphates, silver nitrate, alcoholic solution of cuprous chloride, and acid or alkaline solutions of nitrobenzene with electrodes of platinum (smooth or also platinised), platinum-iridium, or copper. The curves of the same series concord very well. In the copper sulphate the kathode potential drops by about 1 volt, when the electrolyte in contact with the kathode is depleted of sulphate, and remains at that value; in silver nitrate it drops only by 0.2 volt, and recovers under formation of silver crystals; this point requires further investigation. In the cuprous chloride the successive reduction of cupric chloride and the deposition of copper are marked by a break in the curve. In acid nitrobenzene solution the potential also shows retrogression, possibly corresponding to changes in the condition of the kathode. The behaviour of the alkaline solutions of nitrobenzene indicates that Haber's observations as to the dependence of

electrode potential on current density cannot be explained by concentration changes at the electrode. In the discussion, J. K. H. Inglis and R. Threlfall suggested the use of capillary connections which the author avoids, not to introduce convection currents. Threlfall also expressed the opinion that we should first study simple electrolytic phenomena before attacking complicated reactions. H. B.

659. *Electrolytic Analysis of Cobalt and Nickel.* F. M. Perkin and W. C. Prebble. (Faraday Soc., Trans. 1. pp. 108-109; Discussion, pp. 109-110, Jan., 1905.)—Brilliant electrolytic deposits of nickel are easily obtained, and give quantitative analytical numbers, while deposits of cobalt are usually dark and burnt in appearance, and the analytical results are almost invariably too high. The authors have carried out a number of experiments with cobalt in order to obtain the deposit in a bright, and at the same time quantitative, manner. Thinking that the dark deposit was due to oxidation, the first experiments were carried out in the presence of reducing agents, using formaldehyde, formic acid, hydroxylamine, lactic, sulphurous, and hypophosphorous acids. The acids were generally employed in the form of their ammonium or sodium salts, and the solution kept alkaline by the addition of ammonium hydrate. Only in the case of sodium hypophosphite were brilliant deposits obtained; the deposits were not cobalt, however, but a phosphor cobalt containing about 5 per cent. of phosphorus. Somewhat more satisfactory results were obtained by the addition of ammonium oxalate or tartrate, but in all cases the analytical results are slightly too high. This is considered to be due to the deposition of traces of carbon along with the metal. The appearance of the deposit is better from the tartrate solution than from the oxalate solution. To obtain a bright deposit a low current-density should be employed till the bulk of the metal has been deposited. Sometimes a poor and unsightly deposit will give better analytical results than a bright one. Carrying out the electrolysis rapidly or slowly seems to affect the result very little. When the electrolyte contains ammonia and ammonium borate the deposit is almost invariably brown and burnt, but the analytical results are distinctly better than those obtained from solutions containing either the ammonium oxalate or tartrate. The only satisfactory quantitative results are obtained with a solution containing alkali phosphates and free phosphoric acid; the deposit is bright. After the electrolysis has proceeded for a short time there is usually a brown deposit of cobalt oxide on the anode. This can be dissolved off by adding a little hydroxylamine sulphate or chloride to the solution. This method does not give satisfactory results in the case of nickel, but very good analytical results can be obtained from a solution containing ammonia and ammonium borate. With ammonium tartrate the results are apt to be erratic in the case of nickel. T. S. P.

660. *Bromine and the Anode Potential in the Electrolysis of Potassium Bromide Solutions.* F. Boericke. (Zeitschr. Elektrochem. 11. pp. 57-88, Jan. 27, 1905. Elektrochem. Laborat. der techn. Hochschule, Dresden.)—The author investigates, in the first and second parts, the solubility of bromine in KBr and HBr, and the potentials of bromine in those solutions, referring chiefly to M. Wildermann and Jakowkin. In both solvents two degrees of saturation are observed at 0° C., according as the solution is in contact with liquid bromine or with bromine hydrate; the latter solution is the more stable. The saturation curves for bromine and bromine hydrate in KBr are not parallel, but intersect at the bromide concentration 1.88 normal, and

similarly the potential curves of bromine in these solutions intersect at 1.84 normal KBr. The liquids seem to contain, in addition to KBr_2 and HBr_2 (which are analogous to iodine compounds) bodies richer in bromine. In the potential measurements electrodes of platinum with 25 per cent. of iridium were used, because platinum is attacked; the mean resulting bromine potential is at 25° : -1.098 volt ($\text{Cl} = -1.390$, $\text{I} = -0.663$). The third part of the paper deals with the electrolysis of neutral solutions of KBr by means of platinum electrodes, a wire loop cathode and a sheet anode, smooth or platinised, in a Friessner cell. References are made to E. Müller [see Abstract No. 1893 (1902)] and H. Kretzschmar [Abstract No. 277 (1905)]. Owing to the high solubility of bromine in water and in potassium bromide, bromine is discharged on platinised anodes at potentials which lie below the bromine potentials corresponding to saturation even with dense currents; with smooth anodes much higher potentials are required. H. B.

REFERENCES.

861. *Removal of Oxygen by Platinum.* E. Goldstein. (Ber. Deut. Chem. Gesell. 37. pp. 4147-4148, Nov. 12, 1904. Physik. Laborat. d. Sternwarte, Berlin.)—On fusing a platinum wire about 4 mm. thick into a Geissler tube so that about 1 cm. of it projects inside, filling the tube with oxygen and sparking, the platinum becomes white hot, and in about 2 min. the whole of the oxygen is absorbed. T. H. P.
862. *Modification of the Freezing-point Method.* S. W. Young and W. H. Sloan. (Amer. Chem. Soc., Journ. 26. pp. 913-922, Aug., 1904. Stanford University.)—The authors make use of a stirrer consisting of a cylinder of ice. This is first used to agitate the pure water used as solvent while its melting-point is being taken. A known amount of the substance to be dissolved is next added, and the solution obtained kept well stirred with the cylinder of ice, the containing vessel being surrounded by a freezing mixture. When a state of equilibrium is arrived at, the temperature is observed, and the thermometer and stirrer then removed. The cylindrical vacuum-jacketed vessel containing the solution is taken from the freezing mixture and weighed, the weight of the solvent being thus obtained. One ice stirrer is sufficient for six or eight measurements on solutions of increasing concentration, prepared by adding further quantities of the solute and stirring with the ice cylinder. The results obtained with cane sugar and with potassium and sodium chlorides are lower, and, leaving aside some of Raoult's and Richards's measurements, more uniform than those of other authors. T. H. P.
863. *Solubility of Barium and Mercuric Chlorides.* H. W. Foote and H. S. Bristol. (Amer. Chem., Journ. 32. pp. 246-251, Sept., 1904.)—Investigations made by the solubility method to ascertain the existence or non-existence of double salts of barium and mercuric chlorides show that no such salt exists at 25° . Dilatometric experiments indicate a transition point at 17.2° , below which the double salt, $\text{BaCl}_2 \cdot 3\text{HgCl}_2 \cdot 6\text{H}_2\text{O}$, forms; this salt may also be detected by the solubility method at 10.4° . The salt $\text{BaCl}_2 \cdot 2\text{HgCl}_2 \cdot 2\text{H}_2\text{O}$ described by Bonsdorf in 1829 is not formed under the conditions given by this author. T. H. P.
864. *Marckwald's Asymmetric Synthesis of Optically-active Valeric Acid.* S. Tijmstra Bzn. (Konink. Akad. Wetensch. Amsterdam, Versl. 13. pp. 459-461, Jan. 5, 1905. Proc. 7. pp. 465-468, Jan. 25, 1905.)—The author improves Marckwald's synthesis of active valeric acid [see Abstract No. 3027 (1904)] by heating the active hydrogen brucine salt of methylethyl malonic acid which is formed, under reduced pressure, instead of at ordinary pressure. In this way the yield is increased. A. F.